United States Patent [19]

McClain

[11] **4,203,414**

[45] **May 20, 1980**

[54] **STONE CUTTING APPARATUS**

[76] Inventor: **Harold F. McClain**, 9840 Aberdeen, Leawood, Kans. 66206

[21] Appl. No.: **1,422**

[22] Filed: **Jan. 8, 1979**

[51] **Int. Cl.**[2] **B28D 1/32**

[52] **U.S. Cl.** ..... **125/23 C**

[58] **Field of Search** ..... 125/23 R, 23 C, 230; 51/215 E, 215 CP, 61, 80 A

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,514,352	7/1950	Solomito	125/23
2,552,958	5/1951	Graham	125/23
2,753,861	7/1956	Bode	125/23
2,768,620	10/1956	Jenkins	125/23
2,867,205	1/1959	Vesper	125/23
2,881,753	4/1959	Entz	125/23
2,882,888	4/1959	Saloga	125/23
2,912,970	11/1959	Schlough	125/23
3,100,481	8/1963	Stefanick	125/23
3,120,842	2/1964	Cox	125/23
3,424,144	1/1969	Giconi	125/23
3,559,631	2/1971	Mangis	125/23
3,677,258	7/1972	Fletcher	125/23 C
3,809,049	5/1974	Fletcher	125/23 C

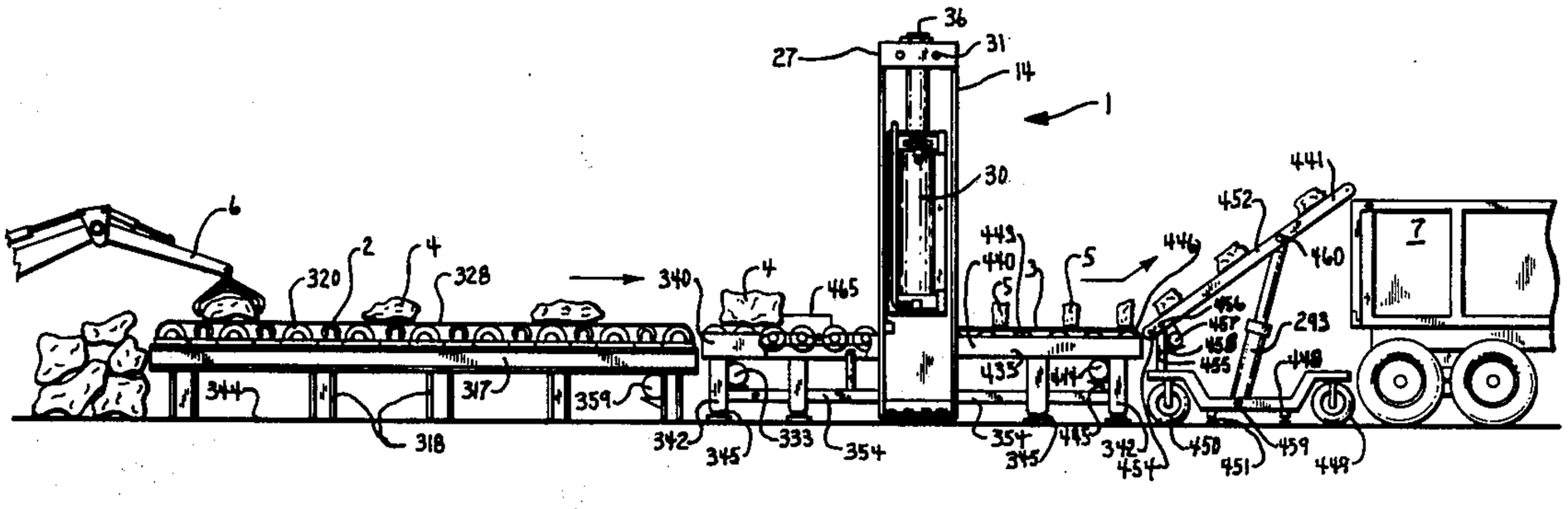
Primary Examiner—Harold D. Whitehead

Attorney, Agent, or Firm—Fishburn, Gold & Litman

[57] **ABSTRACT**

Irregular surfaced slabs of stone are split into blocks of selected width by an apparatus having an upright frame mounted upon a base and with spaced vertical columns connected to opposed upper and lower vertically reciprocal carriages carrying rows of individual power rams each connected to chisels for selected vertical reciprocation relative to the carriage and into engagement with a stone surface. The chisel rams lock into engagement and carriage rams within the columns and on the base move the upper and lower carriages toward each other to split the stone therebetween. Separate hydraulic power units for each carriage and the chisels carried thereon are connected via electrical circuits to a central unit for regulating operation of the apparatus. An upper hydraulic power fluid unit is mounted to the upper carriage for movement therewith and includes a motor driving power fluid pumps and having a reservoir integral with the upper carriage. Centering rams extend inwardly from each column and are operable in combination with a gauging bar assembly mounted on the upper carriage to selectively position the stone for cutting. In-feed and discharge conveyors are respectively positioned for travel of the stone slabs thereon and turntable, walker beam arrangements, and discharge flippers assist handling the stone slabs.

18 Claims, 15 Drawing Figures



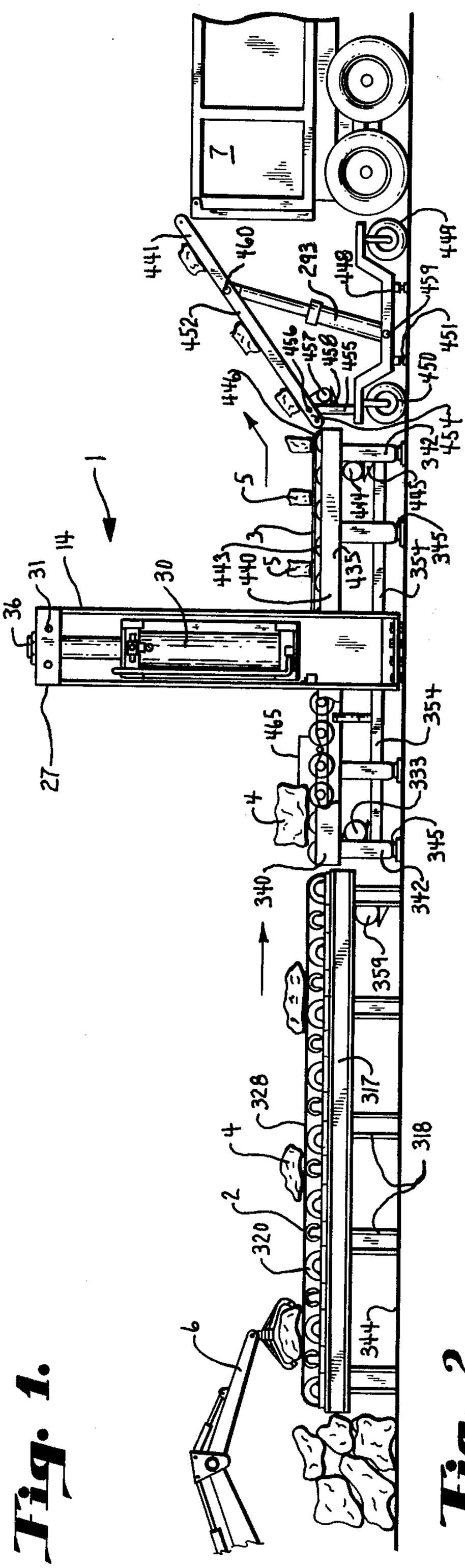

1
2
3
4
5
6
7
27
30
31
36
14
435
440
441
443
445
446
448
449
450
451
452
454
455
456
457
459
460
465
293
340
342
345
354
359
317
318
320
328
344

Fig. 1.

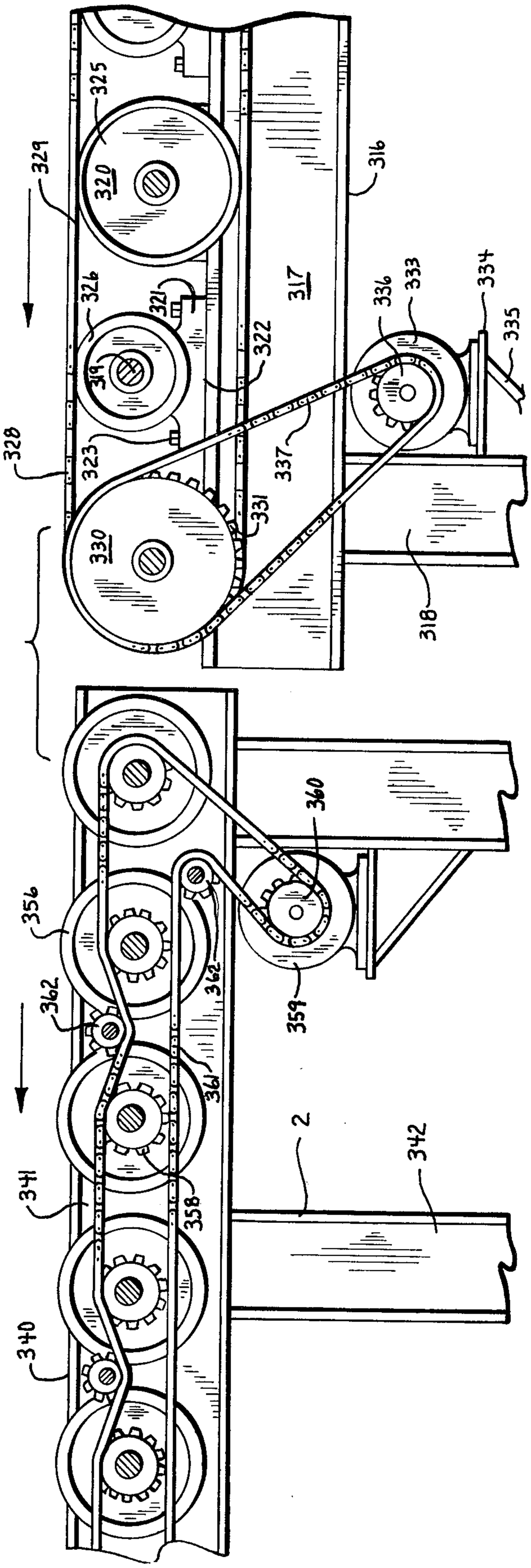

2
316
317
318
319
320
321
322
323
325
326
327
328
329
330
331
333
334
335
336
337
340
341
342
356
358
359
360
361
362

Fig. 2.

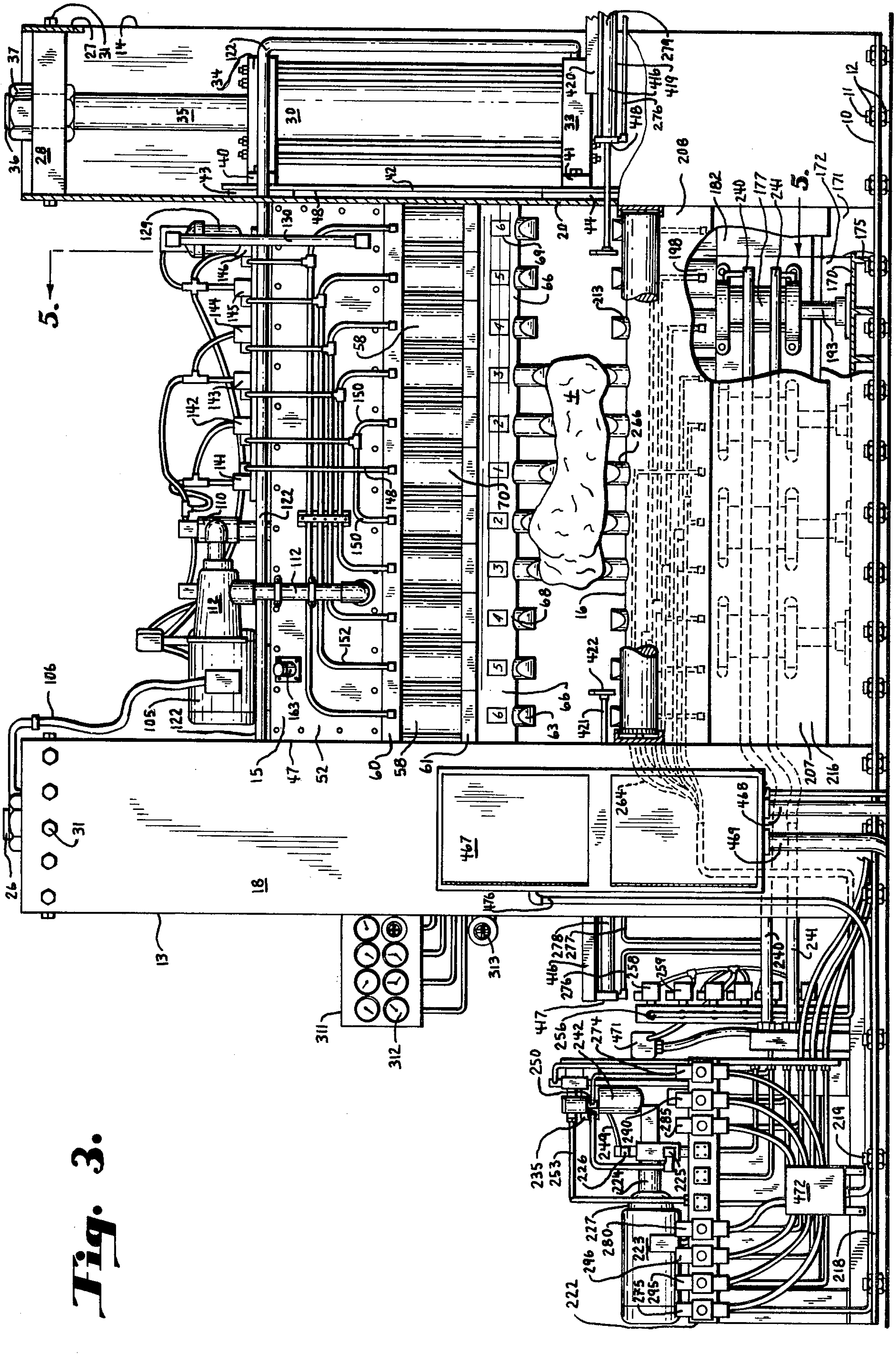

5.
5.
10
11
12
13
14
15
16
18
20
26
27
28
30
31
33
34
35
36
37
40
41
42
43
44
47
48
52
58
60
61
63
66
68
69
70
105
106
110
112
122
129
130
142
143
144
145
146
148
150
152
163
170
171
172
175
177
182
193
198
207
208
213
216
218
219
222
223
224
225
226
227
235
240
241
242
244
249
250
253
256
258
259
264
266
274
275
276
277
278
279
280
285
290
295
296
311
312
313
416
417
418
419
420
421
422
467
468
469
471
472
476

Fig. 3.

Fig. 4.

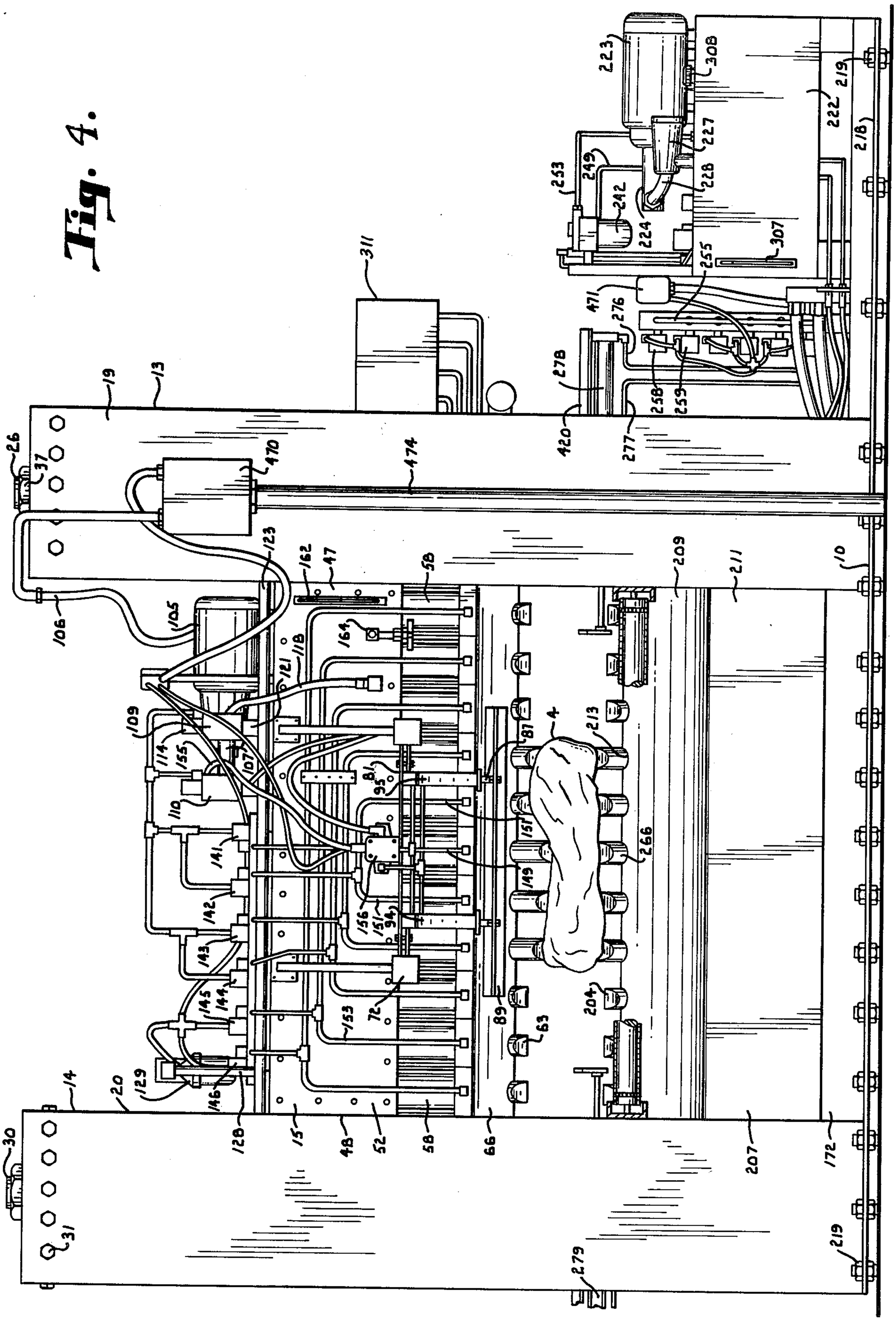
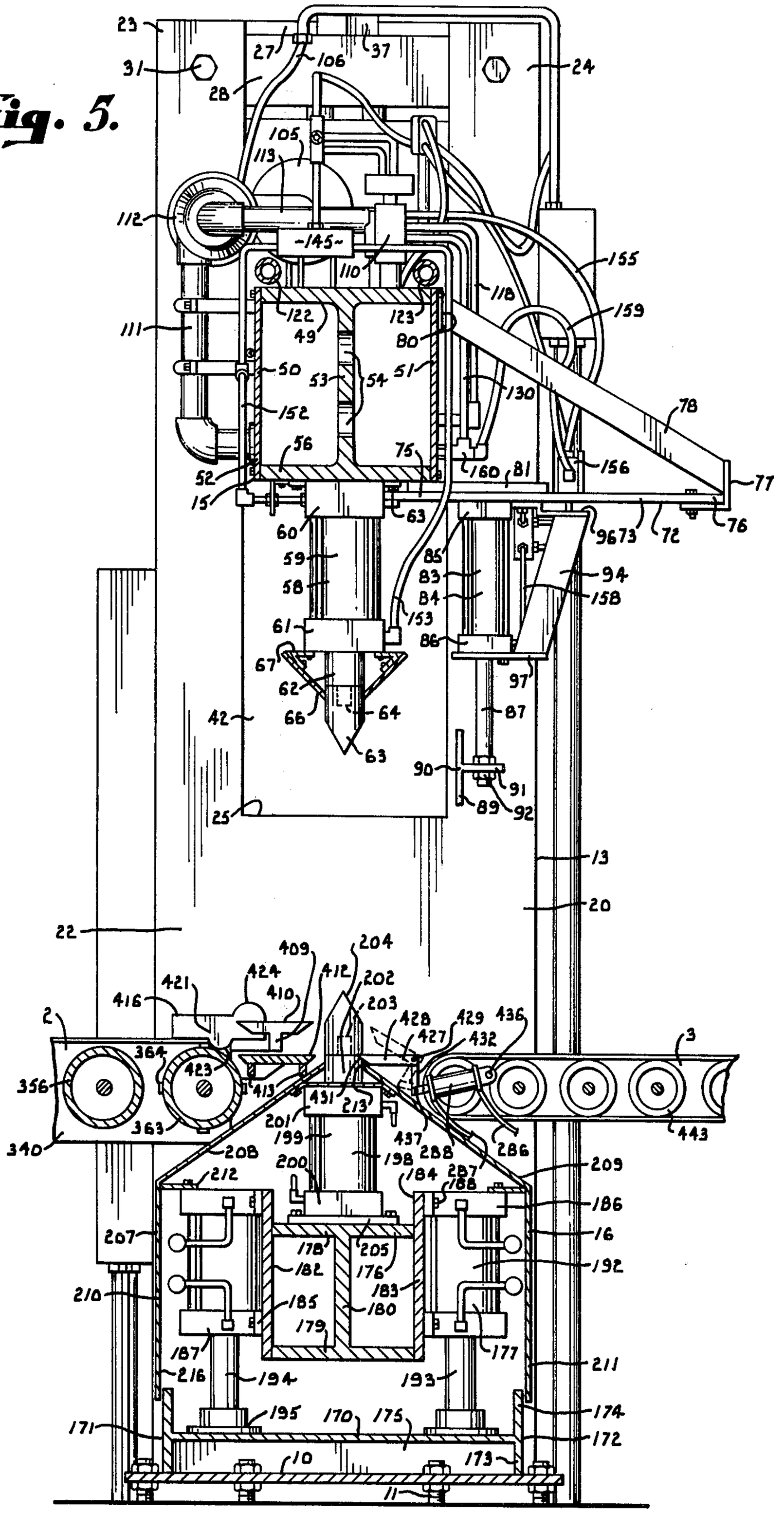

223
308
219
222
218
227
253
249
228
242
224
307
255
471
276
278
258
259
420
277
311
19
13
26
37
470
474
123
162
47
58
209
211
10
106
105
118
121
164
109
114
155
107
81
95
110
141
142
143
145
144
156
151
94
153
72
89
63
204
87
4
213
151
266
149
14
20
129
146
128
15
48
52
58
66
207
172
30
31
279
219

Fig. 5.


23
31
28
27
106
37
24
105
113
112
145
110
155
118
159
111
122
49
123
80
50
53
54
51
130
78
152
56
75
160
81
156
77
52
15
63
60
59
58
61
67
62
66
64
42
63
25
85
83
84
153
86
94
158
97
87
90
91
89
92
13
20
22
409
204
424
412
202
421
410
203
416
428
429
436
427
432
3
2
364
423
413
431
213
356
363
201
199
340
208
200
198
437
288
286
209
212
184
287
188
186
16
207
178
205
192
182
176
183
210
185
180
179
177
187
211
216
194
193
195
170
175
174
171
172
10
173
11

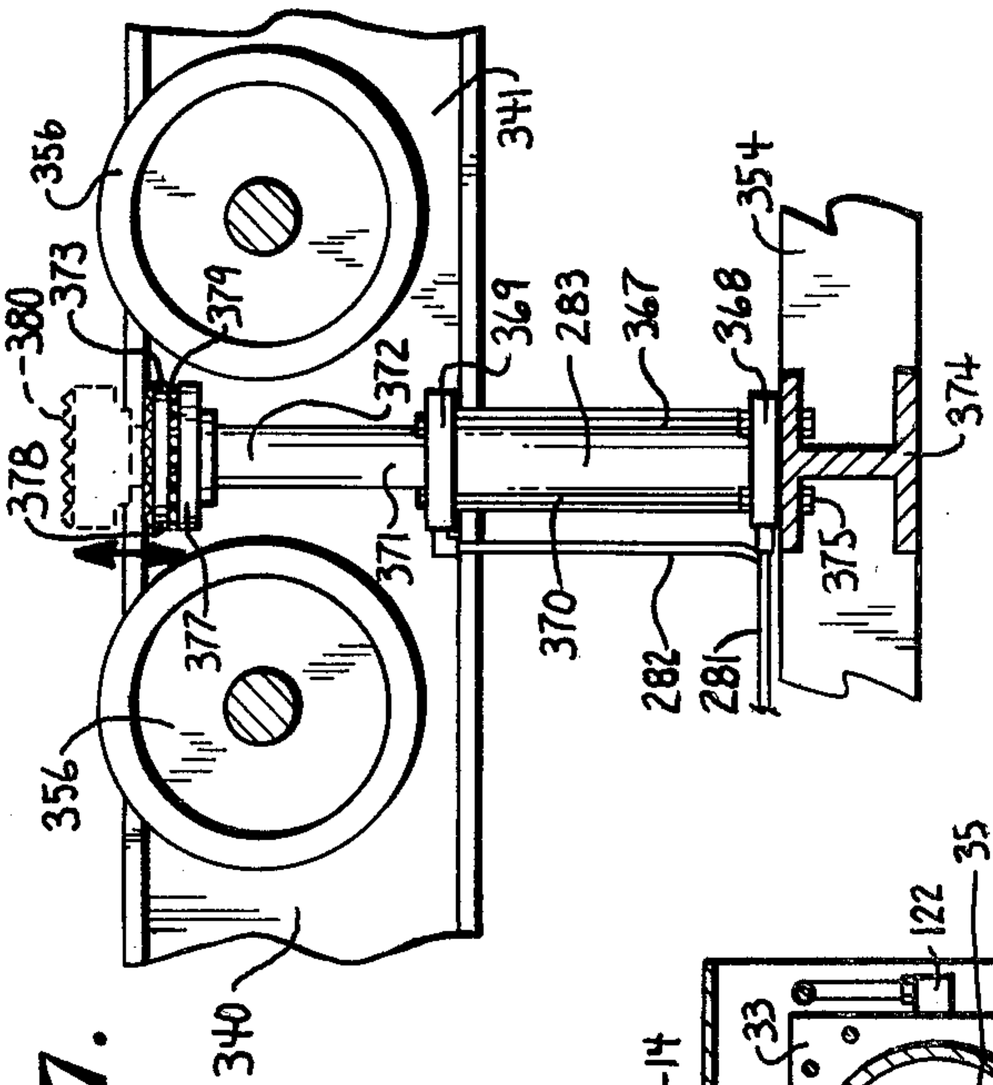


Fig. 7.

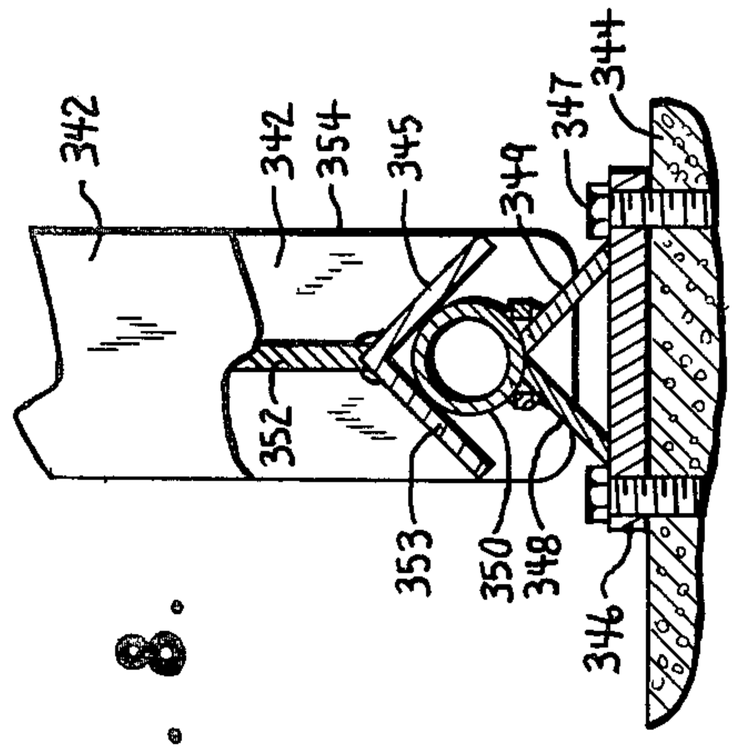


Fig. 8.

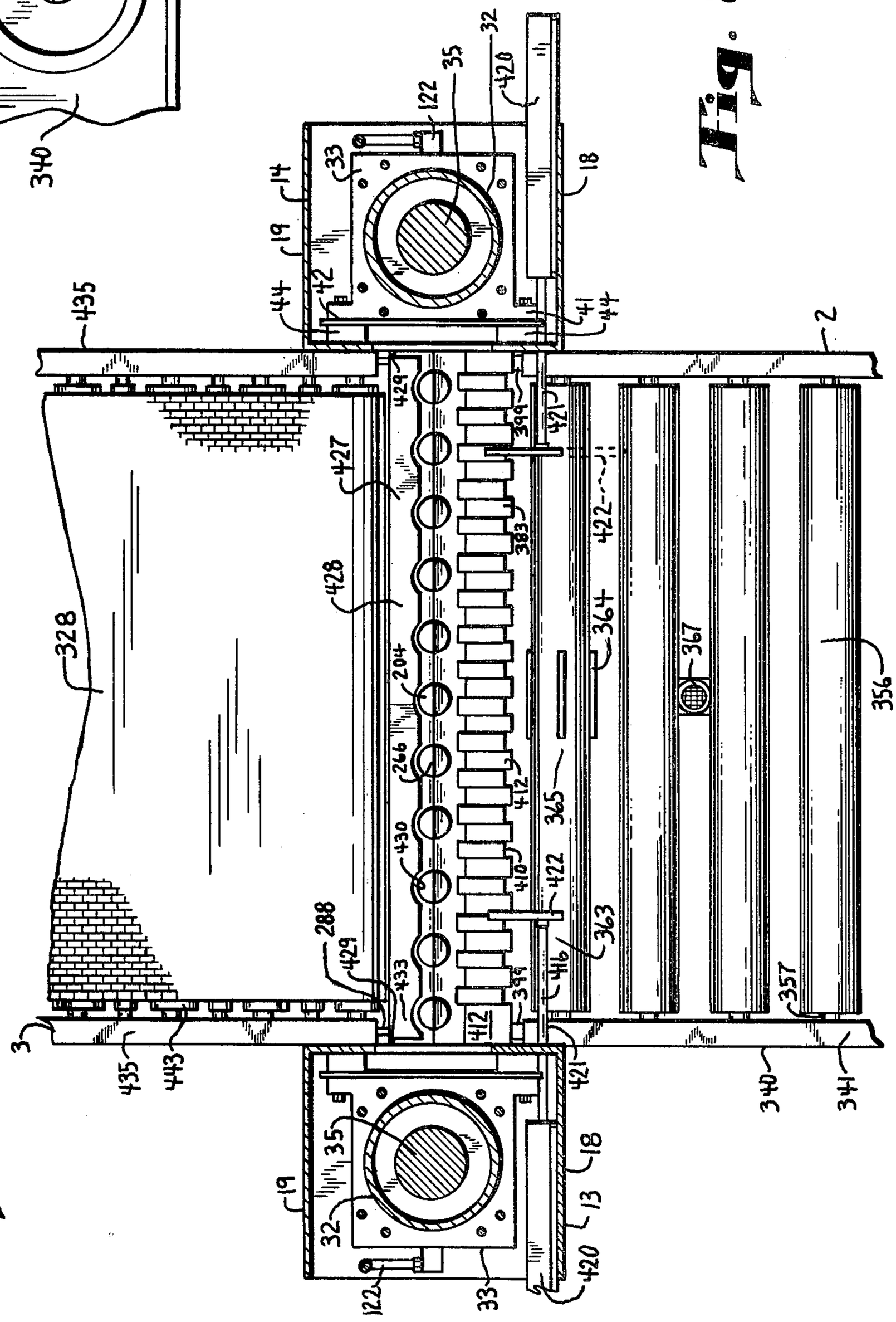


Fig. 6.

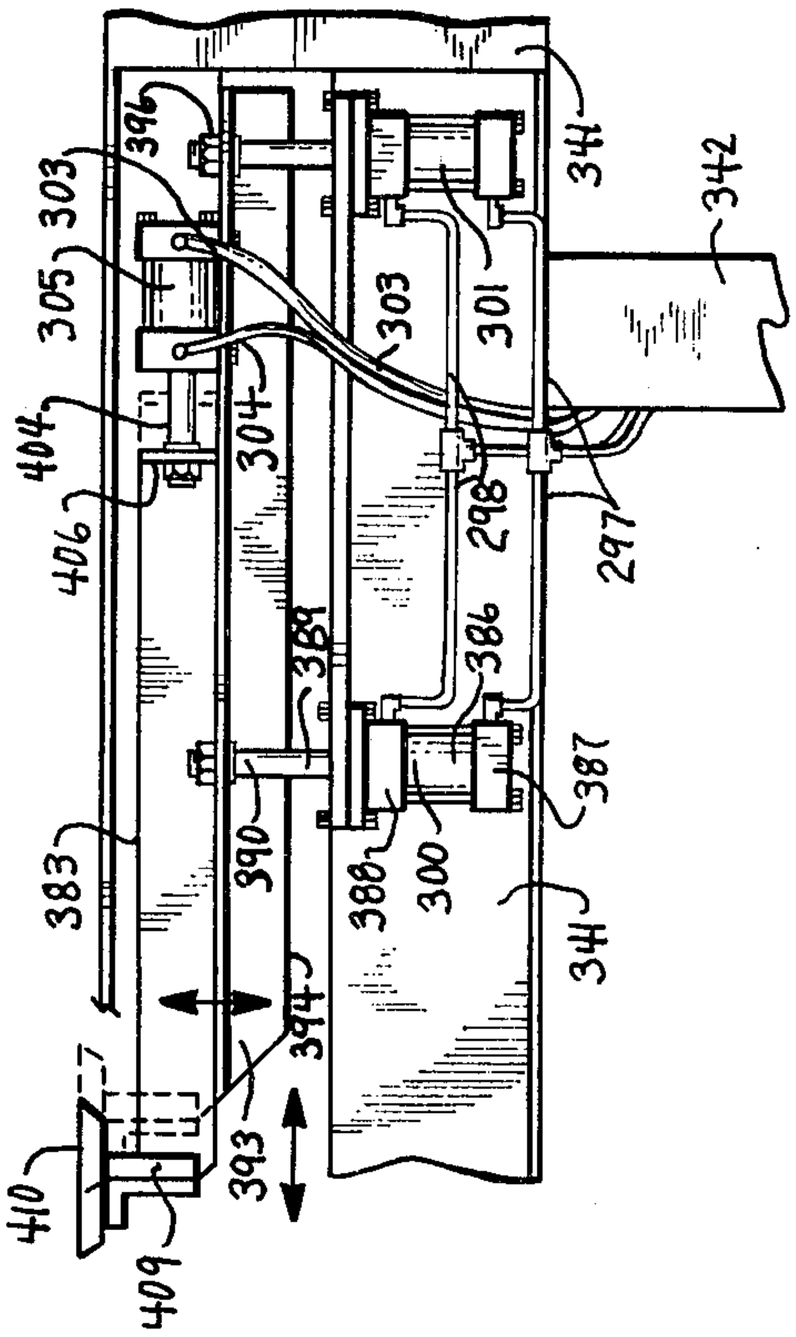


Fig. 10.

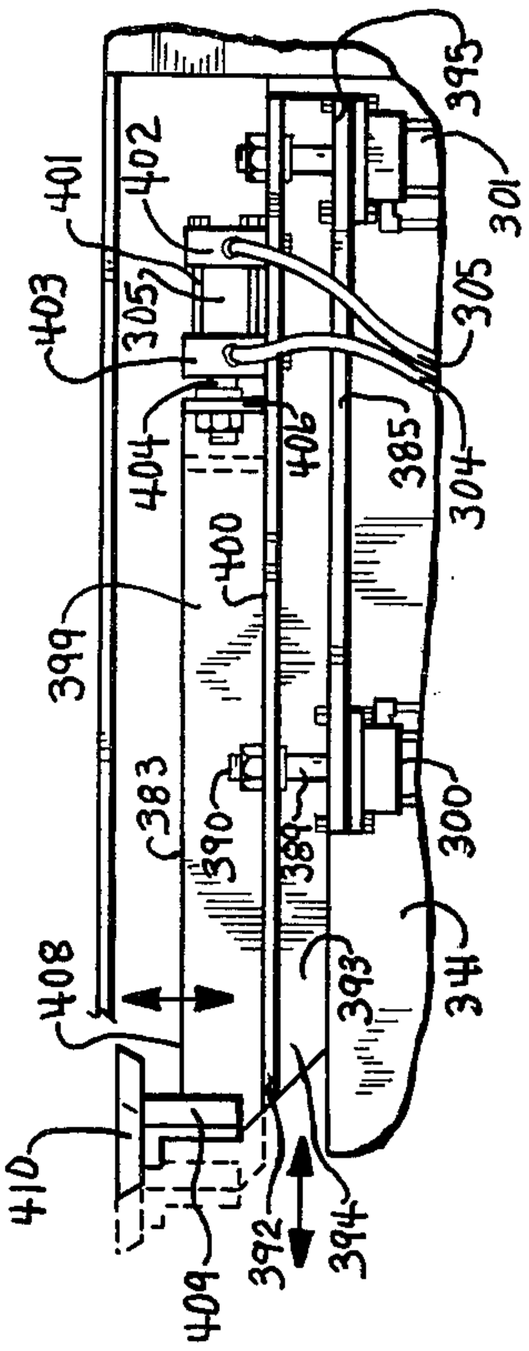


Fig. 11.

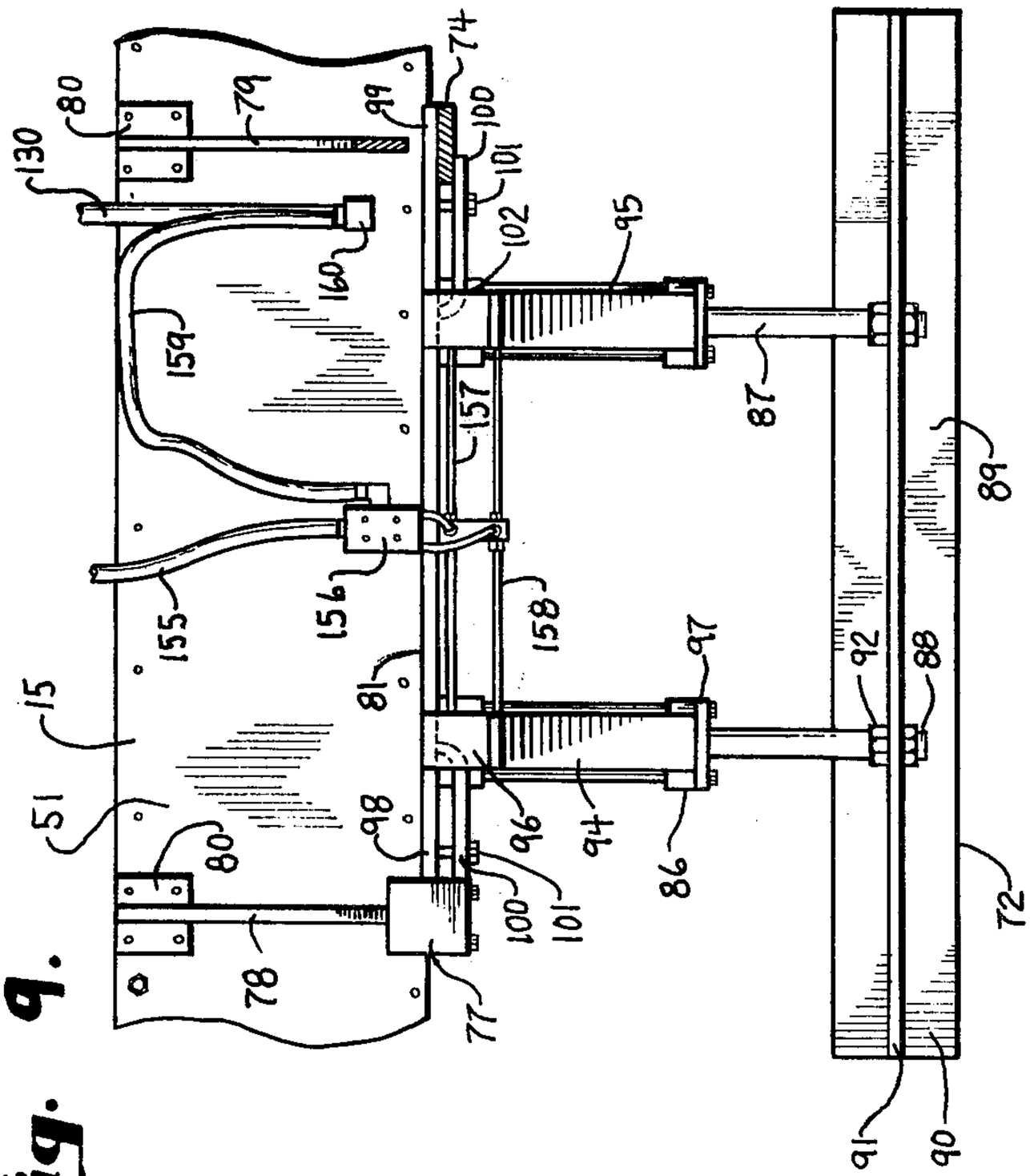


Fig. 9.

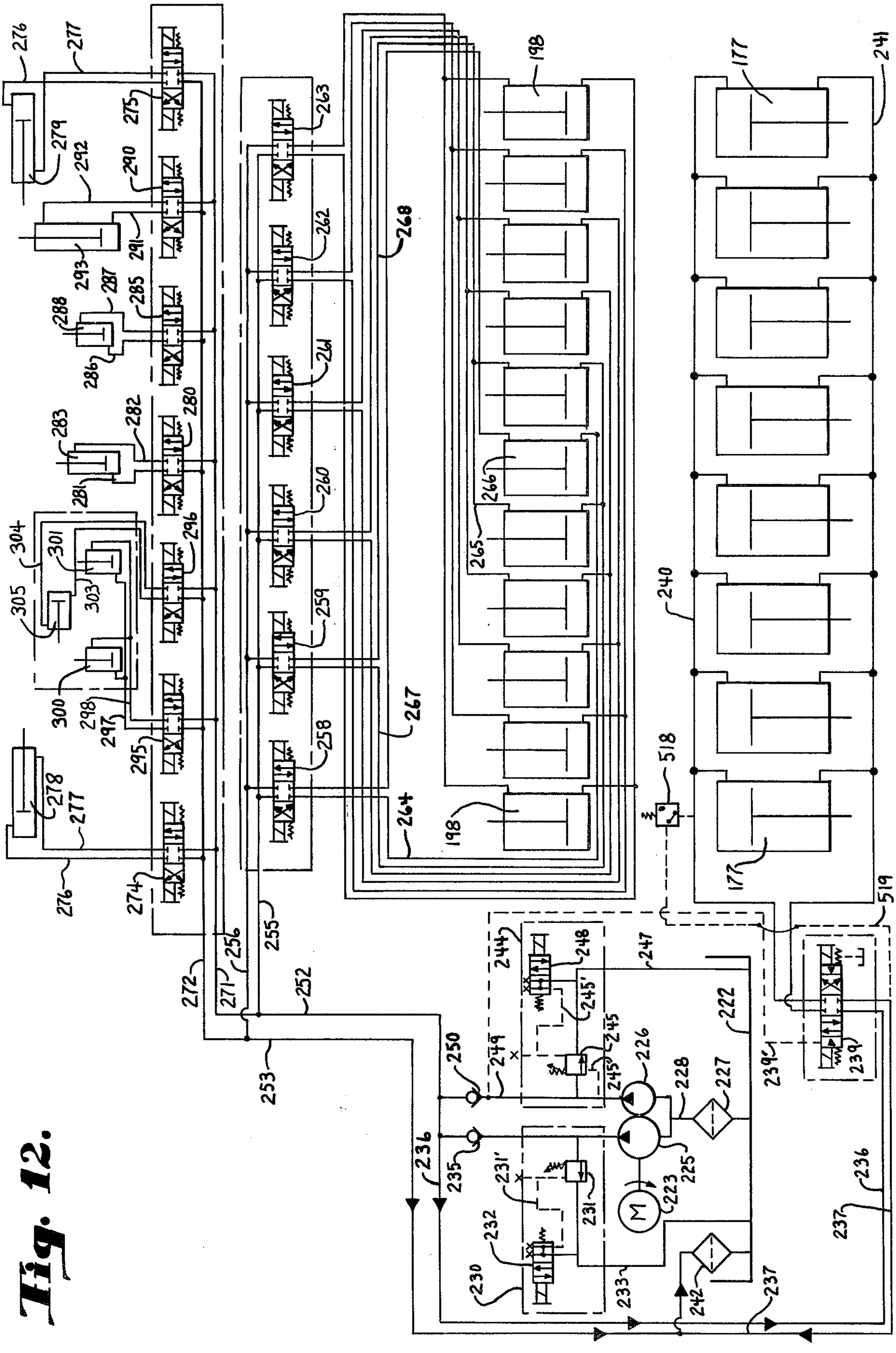

276
277
279
292
275
290
291
293
287
285
288
286
283
282
280
281
304
301
296
305
303
300
298
297
295
278
277
276
274
263
262
268
198
241
177
240
266
265
264
267
258
260
259
255
256
271
272
252
253
518
519
244
248
247
245'
245
222
249
250
226
228
227
239
239'
231'
231
232
230
235
236
223
225
233
237
242

Fig. 12.

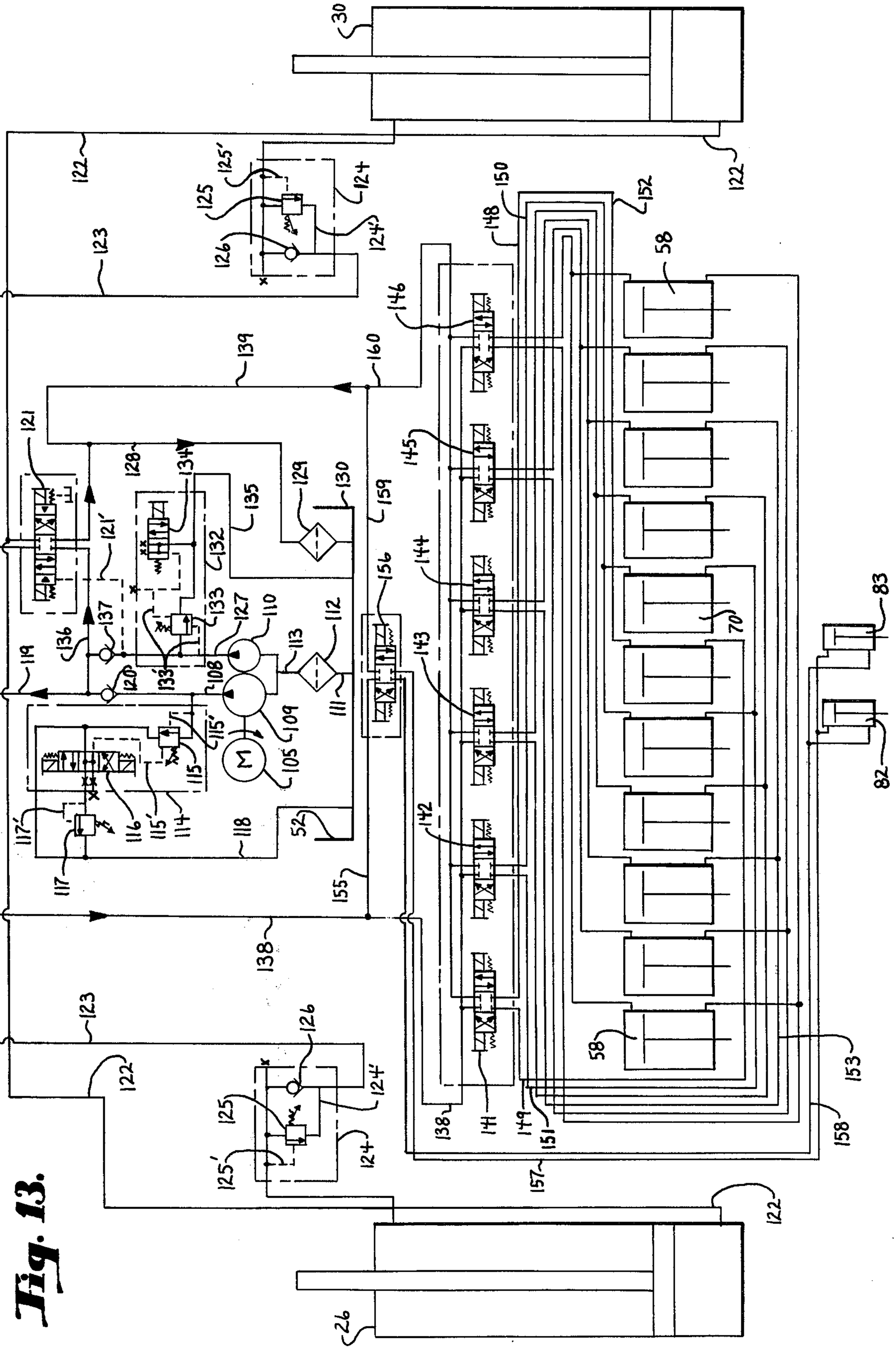

30
122
125'
125
124
126
124'
123
150
152
148
58
146
139
160
121
145
128
134
129
130
135
159
121'
132
144
156
137
133
127
110
112
136
120
133'
108
113
111
119
109
105
115'
115
116
117'
117
114
118
52
155
143
142
138
141
149
151
157
153
158
83
82
70
26

Fig. 13.

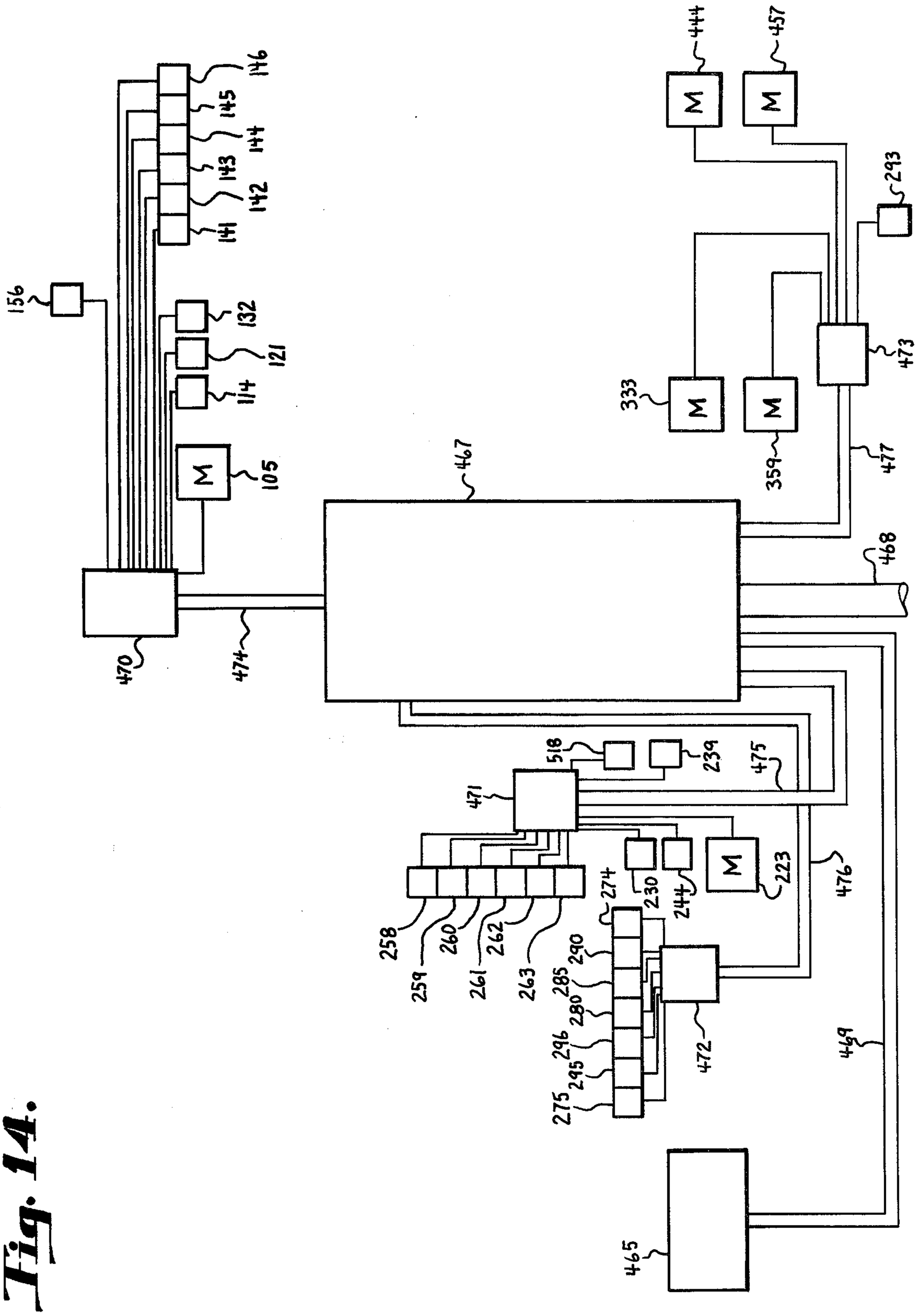

146
145
144
143
142
141
156
132
121
114
M
105
470
474
467
M
M
293
333
M
M
473
359
477
468
518
239
475
471
258
259
260
261
262
263
274
230
244
M
223
476
290
285
280
296
295
275
472
469
465

Fig. 14.

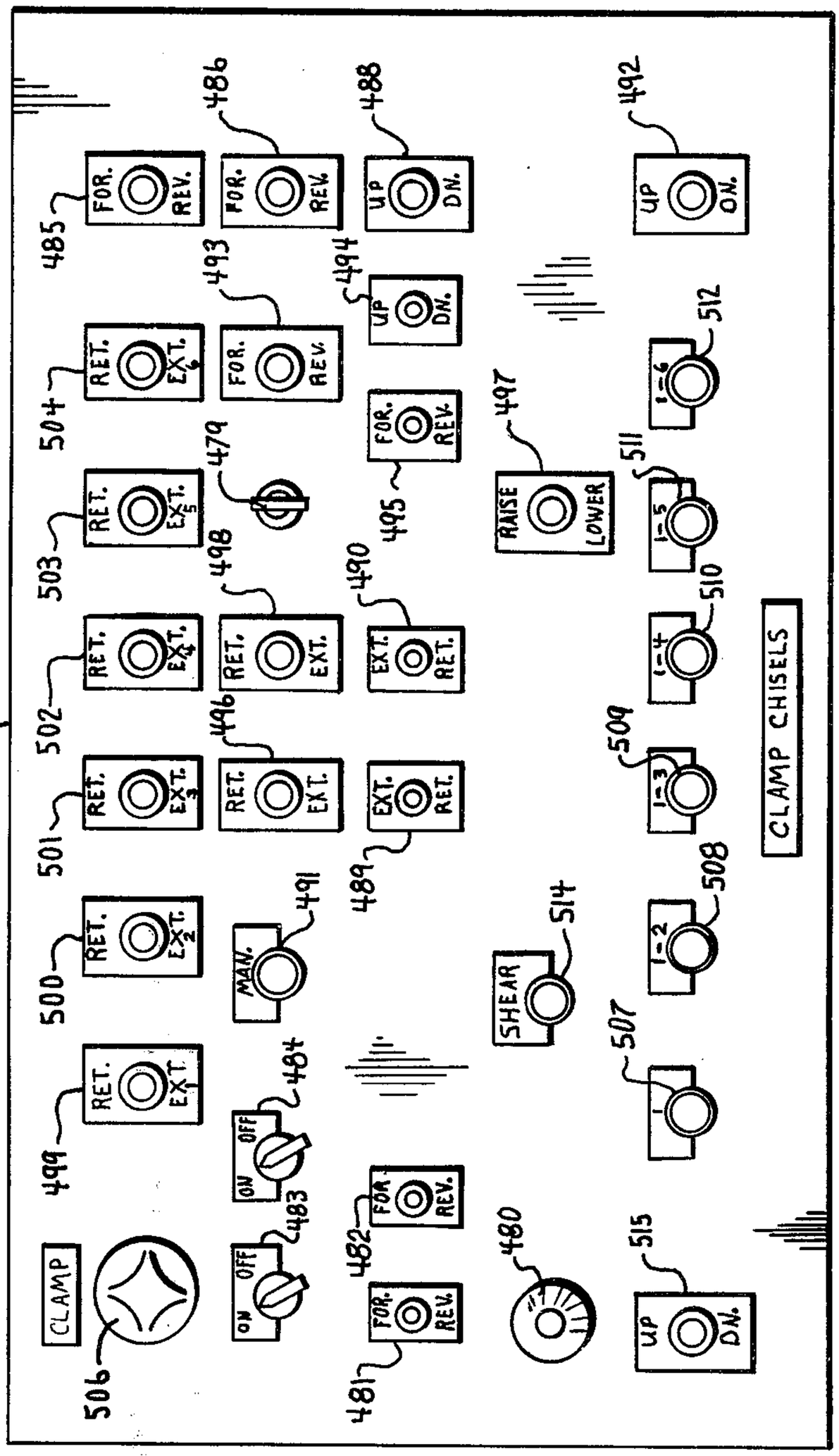

465
485
FOR. REV.
486
FOR. REV.
488
UP DN.
492
UP DN.
504
RET. EXT.
493
FOR. REV.
494
UP DN.
512
503
RET. EXT.
479
498
490
FOR. REV.
495
497
RAISE LOWER
511
I-5
510
502
RET. EXT.
496
RET. EXT.
489
EXT. RET.
509
I-3
I-4
501
RET. EXT.
500
RET. EXT.
MAN.
491
SHEAR
514
508
I-2
507
499
RET. EXT.
484
ON OFF
483
482
FOR. REV.
480
515
UP DN.
CLAMP CHISELS
506
CLAMP
481
FOR. REV.

Fig. 15.

STONE CUTTING APPARATUS

This invention relates to a guillotine cutter or machine in which upper and lower carriages having chisels mounted thereon cut or split the stone into blocks of selected width.

During quarrying operations slabs of stone favored for building masonry material such as granite, quartzite, sandstone, dolomite or dolostone, and limestone are removed from a rock working quarry face and commonly have very irregular top and bottom surfaces. Irregular surfaces, along which the stone naturally splits into horizontally elongate slabs as a result of bedding plane or joint separation, often present a rough exterior characterized by sloping surfaces and projections extending outwardly, for example, from two to five inches or even more.

For such a stone slab to be split properly and into blocks having an elongate, vertical face suitable for building masonry or veneer work, the chisels or teeth of rock splitting machines must engage the irregular surface in a vertical plane and each chisel must exert even pressure relative to the other chisels. If one or more of the chisels does not press downwardly on the stone with force equal to that of the other chisels, the stone will not split evenly therebetween to form a vertical face but instead will form an irregularly split surface.

This problem of evenly splitting a stone has been addressed by many, a common solution being to employ wedge shaped adjusting blocks permitting individual chisels to be retracted or lowered in accordance with the contour of an irregular surface against which the set of chisels is applied. A difficulty arising with these machines is that typically the wedges thereof only operate to position the chisel cutting edge against the stone surface whereupon the wedge is locked into position preparatory to cutting the stroke of the carriage. Because many stone slabs have weathered surfaces which are substantially less solid than the underlying stone body and may have relatively soft shale or mud tenaciously adhering to low portions of the irregular surface, the wedge adjusted chisels typically set aginst non-solid material and cutting pressure exerting by the chisels is thereby often not uniform against the body of the stone, resulting in irregular splits and waste material, and thus increasing the cost of stone cutting in general.

The principal objects of the present invention are: to provide a stone splitting apparatus wherein individually mounted and separately reciprocal chisels are mounted on upper and lower carriages; to provide such an apparatus wherein upper and lower carriages are movable toward each other for stone splitting action; to provide such an apparatus having a plurality of chisels which are brought into engagement of predetermined pressure with opposed sides of a stone slab and by a separate step subsequently cause the stone slab to split transversely of the bedding plane layers; to provide such an apparatus wherein individual chisels are locked into position relative to an irregular surface of a stone and movable thereagainst while conforming to their respective locked positions; to provide such an apparatus having a walker beam structure operable to selectively move stone slabs forwardly and rearwardly for proper splitting position; to provide such an apparatus having centering rams extending outwardly from support columns of the apparatus for locating a stone slab with respect to

center chisels of the apparatus; to provide such an apparatus having a gauging structure located rearwardly of the chisels for controlling the extent of a stone slab positioned between the chisels; to provide such an apparatus having a flipper structure located rearwardly and adjacent to the lower carriage chisels for urging split stone slabs onto a discharge conveyor; to provide such an apparatus wherein rams for upper and lower carriages and chisels mounted respectively thereon are powered by separate hydraulic systems; to provide such an apparatus wherein hydraulically powered components of an upper carriage are located thereon, thereby permitting relatively short runs of power fluid lines for a minimum of leakage and possible line rupture; to provide such an apparatus wherein hydraulically powered components and valve arrangements are arranged to cause the upper and lower carriages to quickly cease cutting action upon splitting of the stone slab; to provide such an apparatus having hydraulically powered upper and lower carriage rams arranged to move in coordination with each other and with cumulatively equal rates of movement and pressures; to provide such an apparatus having hydraulic systems thereof arranged for rapid rate of movement of the upper and lower carriages to position the chisels thereof against the stone slab preparatory to splitting the stone; to provide such an apparatus having a relatively slow rate of movement of the upper and lower carriages during actual splitting operation; and to provide such an apparatus which is sturdy and efficient in use and particularly well adapted for the intended purpose.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings wherein are set forth by way of illustration and example, certain embodiments of this invention.

FIG. **1** is an overall side elevational view of a stone splitting apparatus embodying the present invention and having in-feed and discharge conveyors respectively receiving irregularly surfaced stone slabs and cutting therefrom blocks of stone material suitable for masonry work.

FIG. **2** is a fragmentary, enlarged view of the opposite side of in-feed conveyor from that shown in FIG. **1**.

FIG. **3** is an elevational view of a front side of a stone splitting apparatus and showing portions thereof broken away for purposes of illustration.

FIG. **4** is an elevational view of a rear side of the stone splitting apparatus and showing portions thereof broken away.

FIG. **5** is a transverse sectional view of the stone splitting apparatus and showing interior details thereof and taken along line **5—5**, FIG. **3**.

FIG. **6** is a fragmentary sectional view of the stone splitting apparatus taken along lines **6—6**, FIG. **4** and showing details of centering ram structures and in-feed and discharge conveyors.

FIG. **7** is a fragmentary enlarged view of a portion of the in-feed conveyor and showing a selectively extensible and retractable turntable structure.

FIG. **8** is a fragmentary enlarged view of a mounting structure for connecting legs of the in-feed and discharge conveyors to a base member.

FIG. **9** is a fragmentary enlarged view of a material gauging structure mounted upon a rear side of the stone splitting apparatus.

FIG. **10** is a fragmentary enlarged view of a walker beam structure positioned in front of chisels of a stone

splitting apparatus lower carriage and controllably move stone slabs into position for splitting and showing upward and forward positioning thereof.

FIG. **11** is a fragmentary enlarged view of the walker beam structure and showing downward and rearward positioning of same.

FIG. **12** is a diagrammatic view using ANSI symbols of power fluid components of a lower carriage of a stone splitting apparatus and showing relationship thereof.

FIG. **13** is a diagrammatic view using ANSI symbols of power fluid components of an upper carriage of a stone splitting apparatus and showing relationships thereof.

FIG. **14** is a diagrammatic view of electrical circuitry and related components of the stone splitting apparatus.

FIG. **15** is an enlarged plan view of an operator's control panel for the stone splitting apparatus.

Referring to the drawings in more detail:

As required detailed embodiments of the present invention are disclosed herein, however, it is to be understood that disclosed embodiments are merely exemplary of the invention which may be embodied in various forms, therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure.

The reference numeral **1** generally indicates a stone cutting or splitting apparatus embodying the present invention. Located on opposite front and rear sides of the stone splitting apparatus **1** are an in-feed conveyor **2** and a discharge or out-flow conveyor **3** which transport quarried stone blocks or slabs **4** toward the stone splitting apparatus **1** and, after cutting or splitting thereof, transport the split blocks of building stone or veneer **5** therefrom. As illustrated in FIG. **1**, the quarried stone blocks or slabs **4** are placed upon the in-feed conveyor **2** by means such as a lifting arm **6** and conveyed to a reversable conveyor portion and then maneuvered by the conveyor walkers and lateral pushers to properly center the stone slab in a cutting position with a leading edge against an adjustable stop arranged for desired width of stone cut. After being positioned, chisels engage the stone slab, the stop is removed and then the splitting apparatus operated to effect the cut of the stone for venner blocks. After being cut, the cut piece is moved by the discharge conveyor and loaded into trucks **7** for transport to the job site or arranged in stacks for later use. The stone splitting apparatus **1** is preferably located within a building or suitable enclosure structure (not shown) for protection from adverse weather.

The stone splitting apparatus **1** is massive in structure and is preferably securely mounted to a floor of material such as concrete having sufficient strength to withstand the weight of the apparatus **1**. The apparatus **1** includes a sturdy base **10**, FIG. **3**, such as of steel plate or the like, secured at intervals to the floor by suitable fasteners such as J-bolts **11** with upper and lower nuts **12** adjustable thereon for leveling the base **10** relative to the floor.

Spaced upright columns **13** and **14** are affixed normally to the base **10** and have the stone splitting components of the apparatus located therewith. The upright column **13** and **14** provide means (described below) movably mounting an upper carriage **15** therebetween for vertical reciprocation toward and away from a lower carriage **16** having corresponding movement in the manner of a double acting guillotine for splitting the stone slabs **4** therebetween.

The upright columns **13** and **14** each include front and rear side walls **18** and **19** and inner end walls **20** in right angular arrangement. The inner end wall **20** has a lower portion **22** extending between the margins of the front and rear side walls **18** and **19** and has spaced upper portions **23** and **24** with an opening **25** therebetween communicating with the interior of the column. Bottom margins of the front and rear side walls **18** and **19** and the inner end wall **20** are secured to the base **10**, as by welding, for mounting of the columns **13** and **14**. An elongated plate member **27** respectively extends across the upper portion of the columns **13** and **14** and thick plates or hanger members **28** having marginal dimensions corresponding to the inside dimensions of the columns and of sufficient strength to withstand heavy loads are mounted, as by bolts **31**, within respective upper ends of the columns **13** and **14**. Bores **29** extend vertically through the centers of the hanger members **28** for suspending mounting portions for the upper carriage **15**.

In the illustrated example, the upright columns **13** and **14** have dual-acting carriage rams **26** and **30** respectively reciprocally mounted therein. The carriage rams **26** and **30** each include a cylinder **32**, for example of 12 inches in diameter, and having extension and retraction end caps **33** and **34** and a piston shaft **35** with a free end **36** extended through the hanger member bore **29** and affixed by a suitable fastener such as a nut **37**. The carriage rams **26** and **30** are thereby suspended within the upright columns **13** and **14**, the upper carriage **15** in turn being affixed to the respective carriage rams **26** and **30** for reciprocatory movement therewith as described below. Each carriage ram **26** and **30** includes upper and lower ear members **40** and **41** suitably mounted to respective retraction and extension cylinder end caps **34** and **33**. A vertically elongate plate member **42** extends between the ear members **40** and **41** and parallels the respective carriage rams **26** and **30**. Upper and lower guide ways **43** and **44** mounted on an inward side of the plate member **42** slide against the interior surfaces of the spaced upper portions **23** and **24** of the column.

Opposite ends **47** and **48** of the upper carriage **15** are connected to the respective elongate plate members **42** of the upright columns **13** and **14**. In the illustrated example, the upper carriage **15** includes a horizontal main beam **49**, FIG. **5**, such as an I-beam having wide flanges and enclosed by front and rear walls **50** and **51**. Opposite ends of the main beam **49** are secured to the elongate plate member **42** as by welding, and the walls **50** and **51** form a power fluid holding reservoir **52** integral with the upper carriage **15**. Further, a web **53** of the main beam **49** has a plurality of ports **54** therethrough for circulation of fluid throughout the reservoir **52**.

Extended downwardly from a bottom flange **56** of the main beam **49** and substantially from opposite ends **47** and **48** thereof are a plurality of side-by-side dual acting chisel rams **58** respectively having a cylinder **59**, for example of 5 inches in diameter, and with extension and retraction end caps **60** and **61** with an extensible and retractable piston shaft **62** therein. The extension end cap **60** is affixed to the bottom flange **56** as by bolts **63** for ease of removal and replacement of a chisel ram **58**. A stone engaging removable and replaceable hardened tip or chisel **63** is, for example, threadably connected to

a free end **64** of the piston shaft **62**. Angular cover guards **66** extend over the lower ends of the chisel rams **58** and are connected to horizontally elongate brackets **66** affixed to the retraction end caps **61**. The cover guards **66** include apertures **68** through which respective piston shafts **62** extend.

It is preferred that there be an odd number of chisels with one centered and the others spaced laterally outwardly thereof with the next outward chisels from the center being paired. In the illustrated structure eleven such chisels rams **58** extend along the bottom of the upper carriage **15** and are respectively associated with indicia plates **69** respectively bearing the indicia **1** and indicia **2** through **6** arranged in pairs thereof and identifying the spaced chisel rams **58** to the operator. The indicia plates **69** are arranged in pairs on opposite or left and right sides of a center chisel ram **70**, FIG. **3**, in serially progressing order, the single center chisel ram **70** having the indicia **1** thereover. Each chisel ram **58** has power fluid conduits connected thereto and extending to a source thereof as described below.

On the rearward side of the upper carriage **15** is a material stop or gauging bar structure **72** for selectively controlling the extent of a stone slab **4** positioned for cutting between the upper and lower carriages **15** and **16**. The exemplary gauging bar structure **72**, FIGS. **4**, **5** and **9**, has spaced horizontal bars **73** and **74** extended outwardly of the upper carriage **15** and respectively have inner ends **75** connected to the main beam bottom flange **56** as by bolting. An outer end **76** is connected to a right angle bracket **77** to which are respectively fitted spaced, supportive arms **78** and **79** each extending between the bracket **77** and a plate member **80** adjacent an upper edge of the carriage rear wall **51**. A horizontal beam member **81** is movably supported by and between the outward extending horizontal bars **73** and **74** for forward and rearward sliding. Spaced apart, vertical rams **82** and **83** depend from the beam member **81** adjacent each horizontal bar **73** and **74**.

The rams **82** and **83** respectively include a cylinder **84** with extension and retraction end caps **85** and **86** and arranged to mount the extension end caps **85** to the underside of the beam member **81**. Respective piston shafts **87** are reciprocable from the cylinders **84** and shaft free ends **88** are connected to a horizontal web portion **91** of a bar member **89** including a vertical, relatively wide face or flange **90** to stop movement of the stone slab **4**. The piston shaft free ends **88** extend through bores in the web portion **91** and are secured thereto, as by nuts **92**. For support, spaced braces or arms **94** and **95** extend between lower ends of the cylinder **84** and the rearward edge of the beam member **81**. In the illustrated example, the upper end of each brace or arm **94** and **95** is connected to a right angle bracket **96** on the beam member **81** and the lower end mounted to a plate member **97** on the ram retraction end cap **86**. Opposite ends **98** and **99** of the beam member **81** have clamping structures to control sliding on the horizontal bars **73** and **74** such as a bar **100** frictionally engaging the underside of each horizontal bar **73** and **74** and selectively tightenable thereagainst, as by bolt **101**. An opposite end portion **102** of the bar **100** is curved upwardly and against the underside of the beam member **81** to provide a rocking surface for engagement. As described below, the rams **82** and **83** include power fluid conduits and valve means.

The upper and lower carriages **15** and **16** preferably have separate hydraulic power fluid systems providing relatively short runs of line or conduit and requiring few sections of flexible conduit, thereby minimizing possibility of leakage. Referring to FIGS. **3**, **4**, **5** and **13**, mounted atop the upper carriage main beam **49** is an electric motor **105** having a cord or line **106** connected to a source of electrical power as described below. The motor **105**, by a shaft (not shown) within a housing **107** drives a low pressure, high volume hydraulic power fluid pump **109** and a high pressure, low volume hydraulic power fluid pump **110**, the pumps **109** and **110** having integrated hydraulic lines or conduits as described below providing power fluid for the carriage rams **26** and **30**, the eleven chisel rams **58** and the gauging rams **82** and **83**.

Preferably, the low pressure, high volume pump **109** provides fluid pressurized at up to for example, 500 psi at 30 gallons per minute (gpm) and the high pressure, low volume hydraulic power fluid pump **110** supplies fluid at up to for example, 2650 psi at 8 gpm. The respective pumps **109** and **110** draw hydraulic fluid from the reservoir **52** through a main fluid supply line **111** and a filter **112** and then via supply lines **113** to the pumps **109** and **110**. Fluid from the low pressure, high volume pump **109** flows through a power line **108** with a solenoid controlled relief valve structure **114** connected thereto and internally having a spring-loaded relief valve **115** therein providing pressure control to 500 psi and lines **115'** extending from opposite sides of the valve **115** respectively to a valve entry line and a dual solenoid actuated, three position, spring centered, directional control valve **116**. The directional control valve **116** is preferably energized to a closed position whereby fluid from the pump **109** does not pass through the valve structure **114** and is thereby routed to the various operating rams described below. When open, fluid passes through the valve **116** and to an external spring actuated relief valve **117** providing pressure control to 75 psi. A pilot mechanism **117'** extends from the valve **117** for control. When the valve **114** is energized closed, fluid from the pump **109** flows through the line **108** and through a pressure actuated ball and seat, mechanical, one-way, check valve **120** which for example, opens when the power line pressure reaches approximately 250 psi.

Similarly, fluid from the high pressure, low volume pump **110** flows through a power line **127** to a valve structure **132** internally having a spring-loaded relief valve **133** with port lines **133'** returning to the power line **127** and extending to a single solenoid actuated, two position, spring-offset directional control valve **134** within the valve structure **132** and having integral adjustment for maintaining a preset range of line pressure. The directional control valve **134**, sensing the fluid pressure through a pilot port **133'**, is normally closed and accordingly, the valve **133** is denergized open, permitting fluid to flow through the valve structure **132** and via a return line **135** to the reservoir **52**. When the valve structure **132** is energized closed, fluid from the high pressure, low volume pump **110** flows through the power line **127** to a pressure actuated, ball and seat mechanical, one way check valve **137**, preferably set to open at 250 psi. Thus, fluid from the pumps **109** and **110** flows into a common power manifold or line **136** which is connected directly to a power line **119** leading to control valves for the chisel rams **58** and the gauging rams **82** and **83**.

The common manifold or line **119** also leads to a dual solenoid actuated, spring centered, three position, fair

connection directional control valve **121** having a drain connection and a pilot pressure line **121'** extending therefrom to the power line **127** forwardly of the mechanical check valve **137** for sensing fluid pressure differentials relative to the line **127** and actuating the valve thereby for positioning the flow directing element in the valve **121** by solenoid, spring or pilot function. Extension and retraction lines **122** and **123** are connected to the directional control valve **121** and lead to the carriage rams **26** and **30**.

Interposed in the retraction lines **123** adjacent the respective carriage rams **26** and **30** are counterbalance-type holding valve structures **124** each having a spring biased relief valve **125** internally with a pilot pressure port **124'** and a pilot pressure port **125'**. The pilot pressure ports **124'** and **125'** are each connected to the retraction line **123** on opposite sides of the valve **125**, the pilot pressure port **124'** being connected to the line **123** before a one way ball and seat mechanical check valve **126** with integral adjustment preferably set to open at 250 pounds. The counterbalance holding valve structure **124** is opened upon sensing pressure over 250 pounds in the retraction line **123** and is thereby open for all normal operation. When fluid output ceases, as when the motor **105** is turned off, fluid pressure becomes greater on the ram side of the extension line **123** than on the pump side of the extension line **123**, thereby causing the spring in the valve **125** to move the valve flow directing element and move internal fluid ports from registration. The check valve **126** closes, thereby preventing fluid flow and maintaining the carriage rams **26** and **30** in the position, or degree of extension that they were in at the time of motor shut down.

The upper carriage rams **26** and **30** operate to split the stone slab **4** when the ram extends and fluid from the lines **122** travels back through the directional control valve **121** into a return line **128** having a filter **129** thereon and connected to the reservoir **52** by a line **130**.

The power line **119** extends from the common manifold or line **136** and joins with a power conduit or line **138** connected to valves controlling the upper carriage double acting chisel rams **58**. There are preferably six substantially identical four connection, three position, spring centered, solenoid control, directional control valves **141, 142, 143, 144, 145** and **146** shown in neutral position centered by springs when the solenoids are deenergized. A single such directional control valve **141** is connected via extension and retraction lines **148** and **149** to the center chisel ram **70**, and the directional control valve **142** is connected via extension and retraction lines **150** and **151** to paired chisel rams on opposite left and right sides first adjacent the center chisel rams **70**, each such ram being marked on the cover guard **66** as (2). Likewise, directional control valves **143** and **144**, **145** and **146** are connected via separate extension and retraction lines to paired chisel rams **58** respectively marked as (3), (4), and (5) and (6) on the cover guards **66**. Thus it will be appreciated that, while energizing the directional control valve **141** effects movement of only the center chisel ram **70**, selective actuation of the remaining directional control valves **142** through **146** respectively controls the remaining chisel rams **58** in serially progressing pairs thereof on opposite left and right sides of the center chisel rams **70**. It will further be appreciated that, as illustrated in FIGS. **3**, **4**, and **5**, chisel ram extension conduits, generally indicated by numeral **52**, are positioned on the front side of the upper carriage **15** and retraction conduits, generally indicated by numeral **153**, are on a rear side of the upper carriage **15** for ease of tracing for maintenance and manufacture.

A return line **139** extends from the directional valves **141** through **146** and joins with the return line **128** for passage into the reservoir **52** through the filter **129**. Connected to the power line **138** is a power line **155** leading to a four connection, three position, spring centered, solenoid control, directional control valve **156** which, when energized, selectively routes fluid through extension lines **157** and retraction lines **158** to the rams **82** and **83** to move the gauging structure horizontal bar member **90** into and out of the path of a stone slab **4** traveling on the infeed conveyor **2**. A reservoir return line **159** extends from the directional control valve **156** and joins the reservoir return line **139** at a reservoir inlet fitting **160** for return to the reservoir **52**.

A visual tube gauge **162** indicates the amount of fluid in the reservoir **52** and a filling port **163** and a drain valve **164** are on opposite sides of the reservoir **52**.

It will be appreciated that, in operation of the upper carriage hydraulic system, the motor **105** is constantly running and the pumps **109** and **110** continually supply pressurized fluid. Until required for equipment operation, power fluid from the pumps **109** circulates respectively through the relief valve structures **114** and **132** back into the reservoir **52**, the valves **114** and **132** being deenergized open to circulate the fluid back into the reservoir **52**. In the illustrated example, electrical connections, described below, act upon the various solenoids to route fluid from the low pressure high volume pump **109** through the line **108** through the mechanical check valve **120** and the common manifold or line **136** through the directional control valve **121** and initially move the upper carriage rams **26** and **30** into position relatively close the stone slab **4** for subsequent splitting. It will be appreciated that such movement of the rams **26** and **30** requires great amounts of power fluid yet, as the rams **26** and **30** are called upon only to move the upper carriage without encountering substantial resistance, little pressure is needed. Relatively rapid actuation of the upper carriage chisel rams **58** and the gauging structure rams **82** and **83** is accomplished by the low volume high pressure pump **110** and fluid therefrom is routed through the line **127** through the one way check valve **137** and the common manifold or line **136** into the power line **119** and then through the power line **138** to the directional control valves **141** through **146** and the directional control valve **156**. Additionally, low volume, high pressure fluid from the pump **110** flows through the common manifold or line **136** to the directional control valve **121** and then to the upper carriage rams **26** and **30** for the stone cutting stroke. It will be appreciated that immediately prior to the cutting stroke, the rams **26** and **30** are substantially filled with power fluid and are called upon to extend only a short distance compared to the amount of resistance or pressure which must be overcome to split the stone slab **4**.

The hydraulic system of the upper carriage **15** is acutated in coordination with the hydraulic system of the lower carriage **16**, described below, by suitable means such as electrical or pneumatic. In the illustrated structure, electrical actuation means for both upper and lower carriages **15** are employed as described below in conjunction with description of the overall electrical system.

The lower carriage **16** is mounted between the lower portions of the upright columns **13** and **14** and in vertically aligned, juxtaposed relation to the upper carriage

15. The lower carriage **16** is mounted upon and supported by the base **110** and has an inner, elongate, rigid, horizontal plate **170** with front and rear margins normally connected to horizontally elongate front and rear vertical members **171** and **172** having respective leg portions **173** engaged upon the base **10** and upper free arm portions **174**. A plurality of web stiffeners **175** extend between the base **10** and an under surface of the horizontal plate **170** for rigidly supporting the plate **170** relative to the base **10**.

A main beam **176** is upwardly spaced in parallel relation to the horizontal plate **170** and is movably mounted by a plurality of double-acting lower carriage rams **177**, described below. The main beam **176**, such as an I-beam or H-beam, has wide upper and lower horizontal flanges **178** and **179** connected by a web **180**. Elongate front and rear walls **182** and **183** are secured, as by welding, to respective margins of the upper and lower flanges **178** and **179**, each wall **182** and **183** having an upper arm portion **184** extending above the upper flange **178**. In the illustrated example, the carriage rams **177** each have extension and retraction end caps **186** and **187** and are respectively mounted to the front and rear walls **182** and **183** for vertical reciprocating movement of the main beam **176**. The end caps **186** and **187** each have flanges **185** connected to the respective walls **182** and **183**, as by bolts **188**, FIG. **5**. Preferably, the upper and lower carriages **15** and **16** apply equal force to split a stone slab evenly, the carriage rams **26** and **30** of the upper carriage **15** having the same total volumetric capacity as the carriage rams **177** of the lower carriage **16**. In the illustrated example, rams **26** and **30** have a **36** inch full stroke in order to accept the stone slabs **4** of substantial thickness. During stone cutting operations, the carriage rams **26** and **30** and the lower carriage rams **177** are limited to a 3 inch stroke and spaced so that there is at least a one inch separation between the upper and lower chisels, described below, so that the chisels do not forceably interengage. The exemplary rams **26** and **30** each have a twelve inch inside diameter cylinder with a three inch stroke, thereby comprising a combined volumetric capacity of 678.58 cubic inches. Correspondingly, there are eight lower carriage rams **177** each with a six inch inside diameter cylinder and a three inch stroke, thereby comprising an according 678.58 cubic inches.

The exemplary lower carriage rams **177** comprise four front rams **190** mounted to the front wall **182** on a main beam **176** and four rear rams **191** mounted on the rear wall **183** on the main beam **176**. Each ram **177** has a cylinder **192** and a vertically reciprocable piston shaft **193** with a lower end **194** connected to a foot **195** for distribution of force on the horizontal plate **170**.

Mounted along the upper surface of the upper flange **178** of the main beam **176** are a plurality of lower carriage double acting chisel rams **198** vertically aligned with the upper carriage chisel rams **58** for opposed cutting action. There are preferably **11** chisel rams **198** to accord with the upper carriage chisel rams **58**. Each of the chisel rams **198** includes a cylinder **199**, extension and retraction end caps **200** and **201**, and an extensible piston shaft **202**. A piston shaft free end **203** has a removable and replaceable tip or chisel **204** thereon for engagement with the stone slab **4**. A flange or plate **205** is mounted parallelly to the extension end cap **200** and is affixed to the beam upper flange **178** by suitable fasteners such as bolts.

A cover or guard **207** extends over the lower carriage **16** and has front and rear upwardly convergingly angled top walls **208** and **209** joined with the vertical, spaced, front and rear walls **210** and **211** and connected to the extension end caps **186** of the front and rear carriage rams **190** and **191** by brackets **212** for movement therewith. Vertical openings **213** at the apex or juncture of the front and rear angled top walls **208** and **209** from the chisels **204** and piston shafts **202** to pass therethrough. Lower portions **216** of the front and rear vertical walls **210** and **211** fit over the outside surfaces of the front and rear vertical members **171** and **172** when the main beam **176** is in a lowermost position.

The motor and pumps of the lower carriage hydraulic power fluid system, unlike that of the upper carriage **15**, are mounted upon a base **218** adjacent the upright column **13** and secured to the floor by suitable fasteners such as J-bolts **219**. Referring to FIGS. **3**, **5** and **12**, positioned atop structure forming a reservoir **222** is an electrical motor **223** connected to a source of electrical power as described below. The motor **223**, through a shaft within a housing **224** drives a low pressure, high volume pump **225** and a high pressure, low volume pump **226** corresponding in volume and pressure output to the upper carriage pumps **109** and **110**.

The respective pumps **225** and **226** draw hydraulic fluid from the reservoir **222** through a filter **227** and then via the power line **228** to the pumps **225** and **226**. Fluid from the low pressure, high volume pump **225** flows through a solenoid controlled relief valve structure **230** internally having an integrally adjusted spring-loaded relief valve **231** with a pilot port line **231'** connected to a solenoid-control, spring offset, 2 position, 2 connection, relief valve **232**. When open, the relief valve structure **230** permits fluid from the pump **225** to circulate therethrough and to a return line **233** to the reservoir **222**. When the directional control valve structure **230** is closed, fluid from the pump **225** travels through a one-way, mechanical, ball and seat check valve **235** preferably open at 250 psi and into a common manifold or line **236**. Similarly, fluid from the high pressure, low volume pump **226** travels through a power line **249** to a relief valve structure **244** corresponding to the relief valve structure **230** and internally having a spring-loaded relief valve **245** with a pilot port line **245'** connected to the power line **249** and to a solenoid-control, spring offset, 2 position, 2 connection relief valve **248**. Deenergized open, the relief valve structure **244** normally routes fluid through a return line **247** to the reservoir **222**. Energized closed, the directional control valve structure **244** permits fluid to pass through the power line **249** and a one-way, mechanical, ball and seat check valve **250**, preferably set to open at 250 psi, and into the common manifold or line **236**. A common return line **237** routes fluid back from rams, described below, through a filter **242** and into the reservoir **222**.

Power and return lines **255** and **256** are respectively connected to the common power and return lines **252** and **253** and lead to the lower carriage chisel rams **198**. Preferably, there are six identical four connection, three position, spring centered solenoid control directional control valves **258**, **259**, **260**, **261**, **262** and **263** corresponding to the upper carriage chisel ram directional control valve **141** through **146**. Likewise, a single directional control valve **258** is connected via extension and retraction lines **264** and **265** to a center lower carriage chisel ram **266**, and the directional control valve **259** is

connected via extension and retraction lines **267** and **268** to paired chisel rams **198** on left and right opposite sides first adjacent the center chisel ram **266**, each such ram **198** being vertically paired with an upper carriage chisel ram **58** marked **(2)** on the cover guard **66**. Likewise, directional control valves **260**, **261**, **262**, and **263** are connected via separate extension and retraction lines to paired chisel rams **198** respectively vertically paired with upper carriage rams **58** marked **(3)**, **(4)**, **(5)** and **(6)** on the cover guard **207**. Thus, in accord with operation of the upper carriages or rams **58**, the actuation of the directional control valves **258** effect movement of only the center chisel rams **266** and selected actuation of the remaining directional control valves **259** and **263** respectively move the remaining chisel rams **198** in serially progressing order on left and right opposite sides of the center chisel ram **266**. It will be appreciated that, as illustrated in FIG. **5**, chisel ram extension lines or conduits are positioned on the front side of the lower carriage **16** and retraction lines or conduits are on a rear side thereof for ease of maintenance and construction.

Power and return lines **271** and **272** are connected to lines **252** and **253** and lead to rams for actuation of auxiliary devices associated with the stone splitting apparatus **1**. In the illustrated example and as described below, four connection, three position, spring centered solenoid control directional control valves **274** and **275** are connected to the power and return lines **271** and **272** and have respective extension and retraction lines conduits **276** and **277** extended to rams **278** and **279** for centering stone slabs **4** between the columns **13** and **14** preparatory to cutting or splitting.

A four connection, three position, spring centered, solenoid control, directional control valve **280** is connected to the power and return lines **271** and **272** and has extension and retraction lines conduits **281** and **282** extending therefrom and to a ram **283** for raising a turntable described below, connected to the in-feed conveyor **2** for raising the stone slab **4** thereon.

Another four connection, three position, spring centered, solenoid control, directional control valve **285** is connected to the power and return lines **271** and **272** and with extension and retraction lines **286** and **287** leading to a ram **288** for actuating a flipper mechanism, described below, connected to the outflow or discharge conveyor **3** adjacent the lower carriage **16** for removing cut stones or veneer **5**.

Yet another four connection, three position, spring centered, solenoid control, directional control valve **290** is connected to the power and return lines **271** and **272** with extension and retraction lines or conduits **291** and **292** leading to a ram **293** for elevating a portion of the outflow conveyor **3** as described below.

Further, four connection, three position, spring-centered, solenoid control, directional control valves **295** and **296** are connected to the power and return lines **271** and **272** for actuation of a walker beam arrangement having horizontal and vertical coordinated movement for properly positioning stone slabs **4** between the upper and lower carriages **15** and **16**. Extension and retraction lines **297** and **298** lead from the directional control valve **295** and extend to spaced rams **200** and **301** providing vertical movement for the walker beam arrangement. Extension and retraction lines **303** and **304** lead from directional control valve **296** and extend to a ram **305** providing horizontal movement.

Connected to the common power and return lines **236** and **237** is a four connection, three position, spring-centered solenoid control, directional control valve **239** with a drain connection and corresponding in operation to the directional control valve **121**. A pilot pressure line **239'** extends therefrom to the low volume, high pressure power line **249** forwardly of the check valve **250** for pilot operation of the valve **239** for retraction of the rams **177**. Power and retraction lines **240** and **241** are connected to appropriate ports in the lower carriage rams **177**. The retraction line **241** from the rams **177** to the directional control valve **239** control operation thereof. The fluid back through the reservoir return line **237** and back into the reservoir **222** through the filter **242**.

A carriage over travel or safety pressure switch **518** is connected to the power line **240**, such as in a Tee-fitting, and includes an adjustable fluid pressure actuated electrical switch to break an electric circuit at a set hydraulic pressure drop. In the illustrated example, the pressure switch **518** senses an abrupt drop in line pressure which occurs as the stone slab **4** being cut finally splits. Fluid is immediately vented via line **519** to the reservoir **222** and electrical connection is made to deenergize the solenoids of the directional control valves **121** and **239** and allow the springs thereof to move port connections from registration, thereby stopping movement of the upper and lower carriages **15** and **16**.

A visual tube gauge **307** indicates the amount of fluid in the reservoir **222**. A filling port **308** is on a rear side of the reservoir **222**.

A gauge panel **311** is mounted to the side of the upright column **13** and has a plurality of gauges **312** thereon connected to corresponding power fluid lines for indicating output pressure of the upper carriage pumps **109** and **110**, the lower carriage pumps **225** and **226**, the upper carriage rams **26** and **30** and the upper and lower carriage chisel rams **58** and **177**. A control gauge **313** adjacent the panel **311** senses preset maximum pressure for the upper and lower carriage and chisel rams **58** and **177** for engagement with the stone slabs **4** preparatory to splitting. In the illustrated example, the upper and lower carriage high pressure, low volume pumps **110** and **226** preferably run at up to 2650 psi line pressure. The upper and lower carriages chisel rams **58** and **198** respectively exert up to 125 psi to penetrate and set against relatively soft shale or weathered surfaces on the stone slab **4** and respectively firmly engage the stone. For example, 125 psi can be set on the control gauge **313** and each selected chisel ram **58** and **198** will extend to exert such pressure upon the stone slab **4**. Once firm engagement is effected an electric signal is sent to close the selected chisel ram solenoids **114** through **146** and **258** through **263** and hydraulically lodge the respective extended piston shafts **62** and **202** into engagement with the stone slab **4**. Then, the upper carriage rams **26** and **30** and the lower carriage rams **177** are actuated to move the upper and lower carriages **15** and **16** together and split the stone slab **4** therebetween.

Preferably, the upper and lower high volume, low pressure pumps **109** and **225** run at up to approximately 500 psi line pressure and are used to move the upper carriage rams **26** and **30** and the lower carriage rams **177** generally into position above and below the stone slab **4**. For the cutting or splitting stroke, the low volume high pressure pumps **110** and **226** pump fluid into the upper carriage rams **26** and **30** and the lower carriage rams **177** and exert up to approximately 600,000 psi on each carriage **15** and **16**, thereby comprising a total cutting or splitting force of 1,200,000 psi therebetween.

As described above, in-feed and out-flow or discharge conveyors **2** and **3** are positioned on opposite sides of the stone splitting apparatus **1** for transporting quarried stone blocks or slabs **4** thereto and for removing the slabs **4** after cutting into building stone or veneer **5**. In the illustrated example, FIG. **1**, the in-feed conveyor **2** has first and second sections **316** and **340** comprising elongate, raised platforms. The conveyor section **316** has spaced opposite side beams **317** supported above the floor by legs **318** with a plurality of transverse rollers **320** mounted between the side beams **317** by axles **319** with bearing supports **321** therefor connected to an upper surface **322** of each side beam **317**, as by bolts **323**. Relatively large diameter rollers **325** alternate with rollers **326** of comparatively smaller diameter to provide support for a flexible mesh belt **328** of interconnected flat chain lengths, FIG. **6**. The flexible mesh belt **328** extends across each of the transverse rollers **320** and frictionally engages at least the upper surfaces **329** thereof. A drive means is connected to an end roller **330** with an axially mounted sprocket **331**. In the illustrated example, an electric motor **333** is positioned adjacent and below the end roller **330** atop an arm or bracket **334** on one of the legs **318**. A cord **335** extends to a power source, described below. A sprocket **336** is connected to the electric motor **333** and an endless chain **337** is engaged on the sprockets **331** and **336** in driving relation. Preferably, the motor **333** is reversable for changing the direction of movement of stone slabs **4** and is variable in speed, for example from 2 feet per minute to 22 feet per minute.

The infeed conveyor second section **340** adjoins the stone splitting apparatus **1** and has elongate, parallelly spaced opposite upper and lower side beams **341** and **354** supported by vertical legs **342**. To provide flexing movement as heavy stone slabs **4** move thereover, each of the legs **342** is connected to the floor **344** by a pivotal mount **345**, FIG. **8**, permitting tilting of the leg **342** toward and away from the stone splitting apparatus **1**. In the illustrated example, a plate member **346** is connected to the floor **344** as by J-bolts **347**. Angularly arranged, spaced legs **348** and **349** have lower ends connected to the plate member **346** and are joined at respective upper ends with a transversely aligned, horizontal cylindrical member **350**. Each leg **342** includes a flange member **352** extending downwardly therewith and having angularly arranged legs **353** and **354** connected thereto which tiltably engage the cylindrical member **350**.

A plurality of rollers **356** extend transversely between the upper side beams **341**, FIGS. **2** and **6** and have respective axle shafts **357** rotatably received in bearing supports mounted in the side beams **341**. Each of the rollers **356** includes a sprocket **358** driven by a chain **361** engaged with the respective sprockets **358** and a sprocket **360** mounted to a motor **359**, such as having variable speed and reversable drive. Additionally, sprockets **362** connected to a side beam **341** maintain tension on the chain **361**. The drive arrangement of the second conveyor section **340** is preferably reversable to move stone slabs **4** either toward or away from the stone splitting apparatus **1** and variable in speed from approximately two feet per minute to twenty-two feet per minute for controlling the rate of movement of the stone slabs **4**.

An end roller **363** adjoining the stone cutting apparatus **1**, FIG. **6**, has a plurality of spaced ribs **364** mounted longitudinally around the periphery of a midportion **365** of the roller **363** for engaging and pushing the stone slab **4** between the chisels of the upper and lower carriages **15** and **16**.

A turntable device **367**, FIG. **7**, is mounted in the second conveyor section **340** for elevating a stone slab **4** or a portion thereof and permitting an operator to manually turn the slab to a desired orientation for cutting or splitting. The exemplary turntable device **367** includes the ram **283** having a cylinder **370** with extension and retraction end caps **368** and **369** mounted at opposite ends thereof and respectively connected to the extension and retraction power fluid lines **281** and **282** as described in connection with FIG. **12**. A piston shaft **371** for upward movement between adjacent transverse rollers **356** has a free end **372** with a turntable **373** mounted thereon. The device **367** is mounted upon a beam member **374** which extends transversely between the lower side beams **354**, the ram extension end cap **368** being connected to a middle portion thereof as by bolts **375**.

The exemplary turntable **373** has a lower plate portion **377** fitted atop the piston shaft free end **372** and an upper plate portion **378** rotatably mounted atop the lower plate portion **377**, as by a plurality of ball bearings **379**. The upper plate portion **378** includes an outer surface having a plurality of tooth-like projections **380** for engaging the lower surface of a stone slab **4** as it travels over the turntable device **367**. The turntable upper plate portion **378** is relatively small compared to the size of most stone slabs **4** and only a small portion of the stone slab need be lifted from contact with the upper surface of the transverse rollers **356**. It is normally sufficient that only one side or corner of the stone slab **4** be lifted by the turntable device **367** for manually turning the stone slab **4** by the operator.

As the stone slab **4** is carried by the second conveyor section **340** and approaches the stone splitting apparatus **1**, the ribs **364** on the end roller **363** push the stone slab **4** onto a walker beam arrangement **383**, FIGS. **10** and **11**, positioned at the forward end of the parallel spaced side beams **341**. The I-beams **341** include an inwardly extending flange portion **385** to which vertically directed, spaced rams **300** and **301** are connected such as in longitudinally aligned relationship. The rams **300** and **301** each include a cylinder **386** having extension and retraction end caps **387** and **388** with a vertically reciprocable piston shaft **389**. Respective piston shaft free ends **390** are connected to a flange portion **392**, as by nuts **396**, of an angle beam **393** for vertical reciprocation toward and away from the respective conveyor side beam **341**. The angle beam **393** includes a downward web portion **394** with a lower or bottom edge **395** for contacting the upper surface of the conveyor side beam **341** when the angle beam **393** is in a lowermost position, FIG. **11**.

A second beam **398** is positioned atop the angle beam **393** for horizontal reciprocation and includes an elongate, horizontally extending bar **399** having a lower or bottom edge **400** slidably resting upon the upper surface of the flange portion **392** of the angle beam **393**. The ram **305** is mounted atop the angle beam flange portion **392** in horizontal alignment with the second beam **398** and includes a cylinder **401** with extension and retraction end caps **402** and **403** and a horizontally reciprocable piston shaft **404** connected to a right angle bracket portion **406** of the bar **399**. A forward end **408** of the bar **399** is connected to an end of an elongate, horizontal bar member **409** extending transversely across the end of

the second conveyor section **340** adjacent the lower carriage chisels **204**. A plurality of spaced, parallel fingers **410** are mounted atop the bar member **409** for vertical and horizontal reciprocation therewith as the respective angle beams **393** and second beams **398** move vertically and horizontally. The row of fingers **410** alternate in side-by-side relationship with a row of stationary fingers **412** mounted on front and rear bar members **413** extending transversely of the end of the second conveyor section **340** and connected to opposite inner end walls **20** of the columns **13** and **14**, FIG. **5**. The movable row of fingers **410** are positioned slightly below the stationary row of fingers **412** so that the movable row of fingers **410** can be moved either forwardly or rearwardly with respect to the stationary row of fingers **412** without contacting the lower surface of the stone slab **4** and then lift the stone for moving the same either forwardly or rearwardly so as to selectively position a stone slab **4** between the chisel in proper relation for cutting or splitting.

Power fluid extension and retraction **297** and **298** and **303** and **304** are connected to the conduits or lines **271** and **272** through the respective solenoids **295** and **296** as described above in connection with FIG. **12**. The walker beam arrangement **383** is suitably connected to electrical control means, described below, for forward and reverse movement to move a stone slab **4** toward and away from the lower carriage chisels **204**, such movement being automatically or semi-automatically as selected.

Also aiding in positioning the stone slab **4** for cutting are left and right centering devices **416** mounted to each of the upright columns **13** and **14** in opposed relation and selectively operable to center the stone slab **4** between the center or number **1** chisel rams **70** and **266**. The centering devices **416** each include the rams **278** and **279** each having including extension and retraction end caps **417** and **418** and a cylinder **419** with the extension and retraction lines **276** and **277** suitably connected to the extension and retraction end caps **417** and **418**. The rams **278** and **279** are mounted to the upright columns **13** and **14** on horizontal elongate beam members **420** respectively secured, as by welding, to the inner surface of the front side wall **18** and to the cylinder **419**. A reciprocable piston shaft **421** has a member for engaging the stone slabs **4**, such as an elongate pusher plate **422**, affixed to the free end of the shaft **421**. In the illustrated example, the piston shaft **421** is connected adjacent one edge of the pusher plate **422** so that the plate **422** can be flipped forwardly and a curved projection **423** slidably rest upon the surface of the end roller **363**. Alternatively, the pusher plate **422** can be flipped rearwardly and a curved projection **424** at the other end thereof slidably rest upon a roller **356** positioned rearwardly of the end roller **363**, thereby permitting selective pivoting of the pusher plate **422** for placement against the sides of the stone slab **4**.

The power fluid extension and retraction conduits **276** and **277** for each of the rams **278** and **279** are respectively connected to solenoid actuated directional control valves **274** and **275** as described in connection with FIG. **12**. Suitable electrical control means permit selective extension and retraction of each of the rams **278** and **279** for control of each centering device **416**.

A flipper device **427** having a normally horizontal, elongate bar member **428** extends transversely between the upright columns **13** and **14** and has opposite ends connected to the opposite column walls **21**, as by pins **429**, for upward or flipping rotation in a vertical plane. A forward edge of the bar member **428** includes a plurality of inwardly curved recesses **430** for accommodating the lower carriage chisel ram shafts **202** and the forward edge **431** is angled to rest against the cover guard **209**. An arm **432** depends normally from an end **433** of the bar member **428** for pivotal connection to the ram **288** which in turn is pivotally connected an outflow conveyor side beam **435** by a pivot connection **436**. The other end of the ram **288** has a pivot connection **437** to a free end of the arm **432** thereby comprising a crank arrangement between the bar member **428** and the ram **288** which causes the bar member **428** to rotate upwardly, or flip, upon extension of the ram **288** and return to a substantially level position upon retraction of the ram **288**, as for removing the cut or split stone or venner **5** after cutting by the stone splitting apparatus **1** and flipping the stone onto the outflow conveyor **3**.

Extension and retraction conduits or lines **286** and **287** are connected to the solenoid actuated directional control valve **285** for selected operation after cutting of the stone slab **4**. Suitable electrical control lines extend to a central control panel as described below.

The discharge conveyor **3** includes a stationary first conveyor section **440** and a movable second conveyor section **441** for directing the stone veneer **5** either to the left or right of the first conveyor section **440** and for moving the veneer blocks **5** upwardly for loading into an elevated truck or container. The stationary first conveyor section **440** includes parallel spaced side beams **435** and lower side beams **454**, legs **342** and pivotal mounts **345** as described in connection with the end feed conveyor second section **340**. A plurality of transverse rollers **443** are rotatably connected between the side beams **435** for travel of the blocks of veneer **5** thereover. A flexible mesh belt **328** of interconnected chain links encircles the rollers **443** for transport of the veneer blocks **5**. A motor **444** is positioned on a mount **445** at one end of the first discharge conveyor section **440** and is connected by a sprocket and drive arrangement (not shown) to an end roller **446**.

The movable second discharge conveyor section **441** includes a frame **448** having front and rear pivotal wheels **449** and **450** and floor engaging adjustable feet **451** for positioning the second discharge conveyor section **441** in a selected orientation to the first discharge conveyor section **440**. The conveyor section **440** includes parallel spaced side beams **452** having a plurality of transverse rollers and a flexible mesh belt thereon as described in connection with the first discharge conveyor section **440**. An end portion **454** is pivotally connected, as by pins **456**, to standards **455** extended upwardly from an end of the frame **448** adjacent the second discharge conveyor section **441** for movement of veneer blocks **5** from one section to another. A motor **457** is positioned upon a mount **458** and a chain drive arrangement is connected to an end roller for rotation of the mesh belt.

The ram **293** has opposite ends with pivotal connections **459** and **460** respectively on the frame **448** and on a forward portion of the second conveyor section side beams **452** for raising and lowering of the side beams **452** and the rollers and mesh belt carried therewith upon extension of the ram **393**.

Extension and retraction conduits or lines **291** and **292** are connected to the solenoid actuated directional control valve **290** for positioning of the second dis-

charge conveyor section **441** using an operators control panel as described below.

In the illustrated example, the stone splitting apparatus **1** and the end feed and outflow conveyors **2** and **3** are electrically controlled and include an operators control panel **465**, FIGS. **14** and **15** having a plurality of switches thereon operably connected to circuitry for controlling the various solenoid actuated power fluid valves and motors described above. The control panel **465** is preferably mounted on a stand adjacent the second in-flow conveyor section **340** and the stone splitting apparatus **1** so that the operator may oversee the operation and properly position the stone blocks or slabs **4** for cutting or splitting.

The electric control means, FIG. **14**, includes a main relay box **467** having an electrical cable **468** extending therefrom to a source of power (not shown). The operator's control panel **465** is connected to the main relay box by a cable **469** and controls electrical power to an upper carriage and electrical relay box **470**, lower carriage electrical relay boxes **471** and **472** and a conveyor electrical relay box **473** which are suitably connected to the main relay box **467** by cables **474**, **475**, **476** and **477**.

The operator's control panel **465** includes a key operated off-on main power switch **479** and an emergency "kill" quick shut-off button **480** which removes electrical power from all the solenoids and motors. Toggle switches **481** and **482** respectively control forward and reverse movement of the first and second in-feed conveyor section **316** and **340** and switches **483** and **484** respectively turn on and off the upper and lower carriages motors **105** and **223**. Toggle switch **485** controls movement of the first and second discharge conveyors **440** and **441** and the discharge conveyor lifting or raising ram **293** is controlled by the switch **486**.

A turntable up and down toggle switch **488** controls actuation of the turntable ram **383** to elevate selected stone slabs **4** for positioning by the operator as they travel on the conveyor toward the upper and lower rows of chisels. As the stone slabs **4** approach the rows of opposed chisels, the operator actuates respective left and right centering pusher rams **278** and **279** by left and right pusher toggle switches **489** and **490**. The material stop rams **94** and **95** are extended and retracted by use of a material stop toggle switch **492**. To position the stone slab **4** against the material stop **72**, use of the walker beam arrangement **383** is provided. A walker beam forward and reverse toggle switch **493** actuates circuitry providing automatic cycling movement of the row of movable fingers **410** relative to the stationary row of fingers **412** for lifting the stone slab **4** and moving the same either forwardly or rearwardly as selected. Alternatively, the walker beam rams **300** and **301** providing vertical or lifting movement of the walker beam arrangement is selectively actuated by a toggle switch **494** and the ram **305** providing forward and reverse movement of the walker beam arrangement is selectively actuated by a toggle switch **495**.

Toggle switches **496** and **498** respectively control movement of the upper and lower carriages **15** and **16** for extension for inspection and maintenance and to position the upper carriage next to the stone slab **4** in preparation for cutting. Neither switch **496** and **498** are operative unless a manual push-button switch **419** is actuated, thereby requiring the operator to keep both hands on the control panel **465** and away from moving parts of the apparatus **1**. For inspection and maintenance, the upper and lower chisel rams **58** and **177** are individually extensible in upper and lower pairs thereof by use of toggle switches **499**, **500**, **501**, **502**, **503** and **504**.

When the stone slab **4** is correctly positioned between the opposed rows of chisels, the upper carriage rams **26** and **30** are actuated by use of the toggle switch **496** which positions the valve structure **114** and opens the valve **121** to direct high volume, low pressure power fluid into the rams **26** and **30**. The upper carriage **15** is lowered until the chisels **63** thereof are slightly above the top surface of the stone slab **4**. Next, the operator selects from a series of switches **507**, **508**, **509**, **510**, **511** and **512** which of the upper and lower carriage chisel rams **58** and **177** are to be extended. In the illustrated example, switch **507** operates to extend only the center or "**1**" chisels **70** and **266**, switch **508** extends the three chisels marked "**1**" and "**2**"; switch **509** the five chisels marked "**1**", "**2**" and "**3**"; and so on until all twenty-two chisels of the respective upper carriage **15** and lower carriage **16** are extended and contacting the respective surface of the stone slab **4**.

When the selected chisels seat firmly against the upper and lower surfaces of the stone slab **4** and the rock engagement pressure as set in the control gauge **313** is reached, a light **506** illuminates. The operator then with one hand depresses a button switch **514** marked "Shear" and using his other hand, the operator actuates a toggle switch **497** which routes electrical power to open the valve structures **114** and **230**, close the valve structures **132** and thereby route fluid through the valves **121** and **239** to the upper carriage rams **26** and **30** and the lower carriage rams **177** to move the upper and lower carriages **15** and **16** together and split or cut the stone slab between the extended chisels.

To remove the cut stone veneer **5** from adjacent the chisels, the operator actuates a flipper toggle switch **515** which controls the solenoid actuated directional control valve **285** and the ram **288**. From there, as described above the veneer block **5** travels along the outflow or discharge conveyors **3** for stacking on a vehicle or storage and ultimate use in the building industry.

It will be appreciated that the apparatus **1** can be embodied in many and varied forms. Accordingly, while one form of the invention has been illustrated and described, it is not to be limited to the specific form or arrangement of parts herein described and shown, except insofar as such limitations are included in the following claims.

What is claimed and desired to secure by Letters Patent is:

1. In a stone cutting apparatus having a cutting position with an introducing conveyor for moving a stone to the cutting position and a removal conveyor for moving cut stone therefrom, a cutting apparatus at said cutting position in transverse relation to said conveyors and having spaced columns and upper and lower carriages with cutting chisels carried thereby, said carriage being movable for cutting stone between the chisels, the improvement being stone positioning apparatus including:

(a) a stop member extending transversely of the removal conveyor;

(b) means adjustably supporting said stop member for selective positioning from the chisels the width of a cut piece of stone;

(c) a turntable under a path of stone on the introducing conveyor for engaging stone approaching the

cutting position and facilitating turning of the stone;

(d) a walker apparatus between the introducing conveyor and cutting position and having a plurality of stationary bars laterally spaced apart and extending toward the cutting position and a plurality of movable bars between the stationary bars; and

(e) means operatively connected to the movable bars to selectively move the movable bars up and down and toward and away from the cutting position and cooperate with the turntable in maneuvering a stone into engagement with the stop member and in suitable position for cutting a selected piece therefrom.

2. A stone cutting apparatus as set forth in claim **1** and including:

(a) reversing drive mechanism connected to the introducing conveyors and operative for selectively driving same to advance and retract the stone relative to the cutting position and cooperate with the walker apparatus in selectively moving the stone to engage the stop member in selected position.

3. A stone cutting apparatus as set forth in claim **2** and including:

(a) lateral stone pusher members on each side adjacent to the chisels and upstream therefrom relative to the stone path; and

(b) power means connected to said pusher members and operative to selectively move same toward and away from a stone to center same in the cutting position and cooperate with the walker apparatus to position a stone to be cut.

4. A stone cutting apparatus as set forth in claim **3** and including:

(a) a flipper device adjacent the chisels and downstream therefrom relative to the stone path; and

(b) power means connected to said flipper device and operative to selectively move same to flip the stone downstream from the chisels and deposit same on the removal conveyor.

5. A stone cutting apparatus as set forth in claim **4** and wherein:

(a) the flipper device has opposite ends pivotally mounted to the removal conveyor and an arm secured to said flipper device and extending generally downwardly therefrom; and

(b) said power means includes a reciprocable ram having one end swingably connected to the removal conveyor and another end swingably connected to said arm, the ram being retractable to swing the flipper device into a horizontal position and extensible to tilt the flipper device and flip said stone downstream.

6. A stone cutting apparatus as set forth in claim **1** and wherein:

(a) said stop member is mounted to the upper carriage and movable therewith; and

(b) the stop member includes a support structure on the upper carriage and an elongate bar movable into an arresting position extending transversely of the rearward conveyor, the bar being extensibly connected to the support structure by a power fluid responsive ram.

7. A stone cutting apparatus as set forth in claim **1** and wherein:

(a) said means adjustably supporting said stop member includes a beam member slidably mounted relative to the upper carriage with movement toward and away thereform for selecting a width of stone for cutting.

8. A stone cutting apparatus as set forth in claim **1** and wherein:

(a) the turntable includes a power responsive ram mounted under the introducing conveyor and extensible for projecting above same; and

(b) means mounted to the ram for engaging at least a portion of the stone as the stone moves thereover and lifting said portion above the introducing conveyor.

9. A stone cutting apparatus as set forth in claim **8** and wherein:

(a) the means for engaging a portion of the stone include a rotative device having a lower plate portion affixed to an end of the ram and an upper plate portion rotatably mounted atop the lower plate portion, the upper plate portion having gripping teeth thereon for engaging said portion.

10. A stone cutting apparatus as set forth in claim **1** and wherein:

(a) the stationary bars are supported by a first elongate beam extending thereunder and having opposite ends connected to the introducing conveyor; and

(b) the movable bars are supported by a second elongate beam extending thereunder and having opposite ends connected to said means for selectively moving the movable bars.

11. A stone cutting apparatus as set forth in claim **10** and wherein:

(a) said means operatively connected to the movable bars include spaced pairs of movable upper and lower beam members longitudinally mounted to the introducing conveyor with respect to the cutting position, each lower beam member being movably mounted to the introducing conveyor for up and down movement carrying the upper beam members therewith, each upper beam member having an opposite end of the second elongate beam connected thereto, and the upper beam members being movable toward and away relative to the lower beam members;

(b) first power fluid responsive reciprocable rams extending between the lower beam members and the introducing conveyor for moving the lower and upper beam members and the second elongate beam up and down relative thereto; and

(c) second power fluid responsive reciprocable rams extending between the upper and lower beam members for moving the upper beam members and the second elongate beam toward and away from the cutting position.

12. A stone cutting apparatus as set forth in claim **1** and including:

(a) a movable conveyor section connected to said removal conveyor and having means moving same from up and down for depositing the cut stone in desired upward locations relative to the removal conveyor.

13. A stone cutting apparatus as set forth in claim **12** and wherein:

(a) the movable conveyor section includes an undercarriage having opposite end portions, spaced side beams having respective paired opposite end portions and an article conveying surface with a conveyor belt structure extending between the side

beams; the side beams and article conveying surface overlying the undercarriage;

(b) one of said paired opposite end portions having a pivotable connection to an end portion of said undercarriage for upward swinging movement of said side beam members and said article conveying surface relative to the undercarriage; and

(c) a power fluid reciprocable ram extending between said side beam members and the undercarriage for effecting upward swinging of the side beams and article conveying surface relative to the undercarriage.

14. Apparatus for cutting slabs of stone into pieces of selective width comprising:

(a) a cutter apparatus having a base and spaced apart upright columns at each side of a stone path with a cutting position therebetween;

(b) a stone introducing conveyor including a supporting frame, transverse rollers, and conveyor belt structure operative thereover to support stone slabs on a path to the cutting position and reversing drive mechanism operatively connected to the conveyor to selectively advance and retract stone slabs relative to the cutting position;

(c) a discharge conveyor including a supporting frame, transverse rollers and conveyor belt structure operative thereover with drive mechanism operatively connected thereto to receive and move cut stone pieces from said cutting position;

(d) opposed guide ways on said columns;

(e) upper and lower carriages extending between the columns and movably engaged with said guide ways;

(f) extensible rams mounted in the columns and operatively connected to the upper carriage for raising and lowering same;

(g) extensible rams supported relative to said base and operatively connected to the lower carriage for raising and lowering same;

(h) a plurality of chisel rams carried by each of said carriages in closely spaced relation along the length thereof between the carriages with the chisel rams on the upper carriage being in axial alignment with respective chisel rams on the lower carriage;

(i) a chisel extending from each chisel ram and movable thereby toward and away from a stone slab in the cutting position;

(j) a first power output unit including a drive motor connected to at least one power fluid pump with a reservoir therefor mounted to the upper carriage and movable up and down therewith, said pump on the upper carriage operatively connected to the extensible rams in the columns and to the chisel rams carried by the upper carriage;

(k) a second power output unit including drive motor connected to at least one power fluid pump with a reservoir therefor operatively connected to the extensible rams connected to the lower carriage for raising and lowering same and to the chisel rams carried by the lower carriage; and

(l) actuation control means operatively connected to the first and second power output units and selectively effecting routing of power fluid to the chisel rams, the extensible rams in the columns and the rams connected to the lower carriage for raising and lowering same; the actuation control means including an operator's control panel for operation of said apparatus.

15. The apparatus set forth in claim **14** and wherein:

(a) said first and second power fluid output units each include high volume, low pressure pumps and low volume, high pressure pumps;

(b) said actuation control means effect routing of power fluid from the high volume, low pump on the upper carriage to the extensible rams in the columns for moving the upper carriage downwardly and adjacent the stone slab and for routing power fluid from the respective high volume, low pressure pumps for engaging the chisels carried by the upper and lower carriages with the stone slab at a preselected pressure insufficient to cut same; and

(c) said actuation means effect routing of power fluid from the respective low volume, high pressure pumps to the extensible rams in the columns and the extensible rams operatively connected to the lower carriage for moving the upper and lower carriages and the chisels thereon together to cut the stone slab.

16. The apparatus set forth in claim **15** and including:

(a) means for moving the upper and lower carriages together at an equal rate toward the stone slab for cutting same; and wherein

(b) said means include equal volumetric capacity of the extensible rams in the columns and the extensible rams operatively connected to the lower carriage and equal rates of power fluid flow entering the rams.

17. The apparatus set forth in claim **16** and wherein:

(a) the upper carriage includes a horizontal main beam member with upper and lower flanges and having front and rear walls secured to said flanges and defining said reservoir;

(b) the first power output unit being mounted upon the upper flange; and

(c) the chisel rams for the upper carriage being mounted to the lower flange in depending relation.

18. The apparatus set forth in claim **17** and wherein:

(a) the extensible arms in the columns respectively include a counterbalancing valve structure each with a body having a ball and seat arrangement therein and a spring biased return relief valve having a conduit connection to a conduit means on a pump side of the ball and seat arrangement body and at least two conduit connections to conduit means on a ram side of the body, one of said ram side conduit connections being registerable with the conduit means on the pump side of the body; and

(b) said spring is set to return and register said one ram side conduit connection with the pump side conduit only upon entry of power fluid into said relief valve through the remaining ram side conduit connection having a preselected pressure greater than said spring.

* * * * *